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Plate VIII. Frontispiece

HADLEY'S QUADRANT.

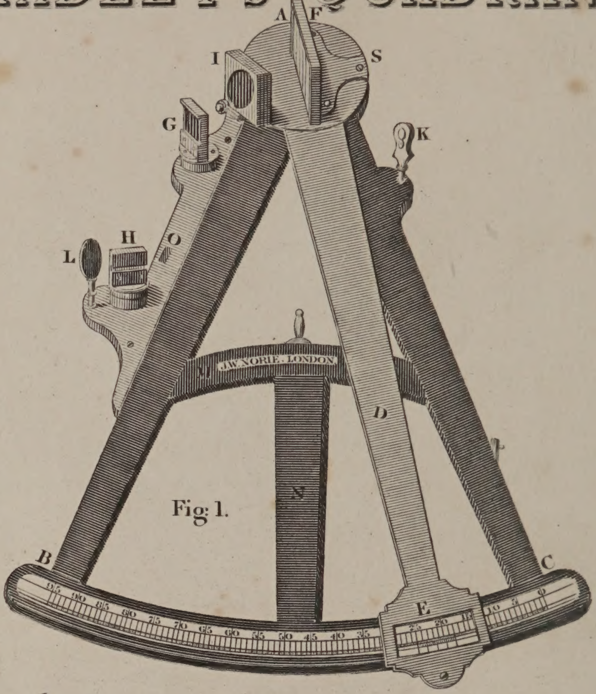

Fig: 1.

AZIMUTH COMPASS.

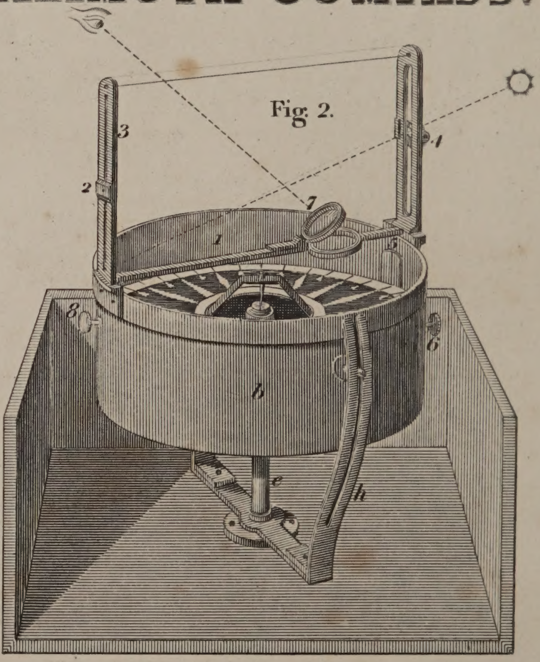

Fig: 2.

J.W.Norie delin.t J.Dower Sculp.

A COMPLETE EPITOME OF Practical Navigation,

CONTAINING
ALL NECESSARY INSTRUCTION FOR KEEPING A SHIP'S RECKONING
AT SEA:
WITH THE MOST APPROVED METHODS OF ASCERTAINING
THE LATITUDE,
BY MERIDIAN, SINGLE, OR DOUBLE ALTITUDES,
AND
THE LONGITUDE,
BY CHRONOMETERS, OR LUNAR OBSERVATIONS;
INCLUDING
A Journal of a Voyage from London to Madeira;
AND EVERY OTHER REQUISITE TO FORM
THE COMPLETE NAVIGATOR;
THE WHOLE BEING RENDERED PERFECTLY EASY, AND ILLUSTRATED BY
SEVERAL ENGRAVINGS.

TO WHICH IS ADDED
A CORRECT AND EXTENSIVE
SET OF TABLES,
PRECEDED BY A COPIOUS EXPLANATION OF EACH TABLE.

BY J. W. NORIE.

Eighteenth (Stereotype) Edition,
CONSIDERABLY AUGMENTED AND IMPROVED;
AND ADAPTED TO THE **New Nautical Almanac**, PUBLISHED BY ORDER
OF THE LORDS COMMISSIONERS OF THE ADMIRALTY,
BY ARTHUR B. MARTIN, F. R. A. S.,
TEACHER OF MATHEMATICS, NAVIGATION, AND NAUTICAL ASTRONOMY.

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TO THE HONOURABLE

THE COURT OF DIRECTORS

OF THE

UNITED EAST INDIA COMPANY,

WHO

SO LIBERALLY ENCOURAGE WHATEVER TENDS TO THE
PROMOTION OF USEFUL KNOWLEDGE,

THIS TREATISE ON

PRACTICAL NAVIGATION,

IS, BY PERMISSION,

AND WITH THE GREATEST RESPECT,

DEDICATED

BY THEIR MOST OBEDIENT, HUMBLE SERVANT,

JOHN WILLIAM NORIE.

PREFACE.

HAVING been for several years past engaged in the instruction of persons designed for, or belonging to the Sea, I have frequently had occasion to lament that most of the existing Works on Practical Navigation, and particularly some that have been very generally circulated, are extremely erroneous, both in the instructive and tabular parts, and by no means calculated to answer all the purposes of the Mariner, Teacher, or Pupil.

With a view to remedy these defects, and to facilitate the acquirement of this most important Art, and further stimulated by the flattering reception of my former labours, I have ventured to exert my best abilities in composing the present Work; and although I do not mean to arrogate to myself any superior professional merit, yet I humbly apprehend that my long experience, and intimate connection with the subject, have enabled me, in some measure, to form a competent judgment of what is most requisite to assist the industrious Mariner in acquiring a knowledge of the practical part of Navigation.

In order to accomplish my intended purpose as effectually as possible, I have examined, with the greatest attention and caution, the various publications that have been written on Navigation; and, placing them in a comparative point of view, have, I trust, been thence enabled to avoid the errors, and to improve the merits of those who have preceded me in this branch of Science.

That nothing might be wanting to assist the student in his progress through the subject, I have commenced with a short Treatise on Decimal Arithmetic, the nature of which he will find very necessary to be understood in going through the various computations that follow. In Geometry such definitions and problems only are introduced as appear most essential. Plane Trigonometry, both right and oblique-angled, being the foundation of the Sailings, is treated of at considerable length. Next follows Geography, containing a description of the form and magnitude of the Earth, with its various real and imaginary divisions, and an explanation of the nature of Latitude and Longitude. An account is then given of the Instruments used for measuring a Ship's Way, with the manner of correcting their errors. This finishes the introductory part to Navigation.

We now proceed to the various Sailings, in which the examples are resolved by construction, calculation, inspection, and Gunter's Scale; then follows a description of Charts, with the methods of using and constructing them. The art of surveying Coasts and Harbours, being very essential to those who visit unknown parts, is treated in a manner which it is hoped will make its acquisition and practice perfectly easy.

We come next to the application of Astronomy to Navigation; and here I have thought proper to give a short but comprehensive view of the Solar System, where the Earth is considered as a planet; and have then described the various imaginary circles of the Sphere. The nature of Parallax, Refraction, &c. is explained under this head. The theory of the Winds and Tides, with the methods of finding the Time of High Water, follow next in order.

The most approved methods of ascertaining the Latitude and Longitude at Sea by Celestial Observations, also the variation of the Compass by Amplitudes and Azimuths, are explained by proper rules and examples: there is also given a particular description, with the uses, of the various astronomical Instruments employed in taking the Observations. In this part of the Work I have given Mr. Douwes' Rules for computing the Latitude by two Altitudes of the Sun, and four different methods of clearing the distance; the last of which, invented by Captain

Mendoza Rios, has the advantage of not requiring any distinction of cases. The method of finding the Longitude by a Timekeeper being now much practised, the necessary rules and examples are introduced for that purpose.

The learner is next led into the Rules for keeping a Journal at Sea, wherein are exhibited the methods of correcting the Courses for Leeway, Variation, &c. with general Rules for working a Day's Work; and the whole is illustrated by separate Day's Works, and further, by a Journal kept from England to Madeira.

With respect to the Tables in this Work, I have only to observe here, that they are published under the title of "*Nautical Tables;*" have been very generally adopted by the Officers in the Navy, and in the Merchant Service; and have received the approbation of Navigators in general.

In preparing for the press the sixth Edition of this Treatise, I was induced, from an earnest desire to render the Work still more useful, to revise the whole with the greatest care and circumspection. In doing this, I made considerable additions, particularly on the subject of determining the Latitude and Longitude by Celestial Observations. In the Rules for correcting the apparent Distance for the effect of Parallax and Refraction, I introduced a fifth method, which, with the assistance of a Set of Linear Tables, invented and published by me, is rendered one of the easiest and shortest that have been proposed. I also treated at considerable length on the use and management of Chronometers, with the method of examining and comparing their Rates; added several new Tables, and corrected the Latitudes and Longitudes of places according to the most modern and best authenticated observations: in short, having obtained the generous and valuable assistance of Mr. George Coleman, F.R.A.S., and many years an Officer in the Service of the Honourable East India Company, who has aided me in all subsequent Editions, have made many alterations and improvements that long experience and unremitted attention have suggested: I trust, therefore, that the "Complete Epitome of Practical Navigation" will continue to merit that approbation which it has always hitherto experienced, from a liberal and enlightened Public. J. W. NORIE.

In the present edition, various improvements have been made to facilitate and simplify the many subjects it contains; among which, has been shewn the method of determining the Latitude by an altitude of the Polar Star, examples being given in reference to the Rules, as stated in the Nautical Almanac for 1866 (*vide* pages 542–3), in which will be found Rules, with an example on this subject.

Examples are worked in this Edition, shewing how the variation of the compass by an azimuth may be obtained, by the sights taken for determining the Longitude by chronometer, (*vide* pp. 245 and 246.)

A very concise and simple method of determining the Longitude by Lunar Observations, is inserted, being the shortest of any hitherto proposed, called "LYON'S METHOD IMPROVED:" it consists of *Addition throughout*, and is performed by Tables common to all Books on Navigation and Nautical Astronomy, except that which determines the third arc; the whole of the operation contained between the apparent distance and the true is obtained by *three tables*, and consists of *eight lines only*.

GEORGE COLEMAN, F.R.A.S.

This edition of the Epitome of Navigation (with the Examples it contains) has been carefully computed and adapted for the year 1866, in order that the learner may procure the Nautical Almanac for that year, and thereby be enabled to go through the various calculations inserted, with the assistance of that valuable and indispensable publication.

The Table, (LVII.) shewing the times of High Water on Full and Change days of the Moon, &c., has been considerably enlarged, and inserted from the latest authorities to the present time. ARTHUR B. MARTIN, F.R.A.S.

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EXPLANATION AND USE

OF

THE TABLES.

TABLES I. AND II.

Difference of Latitude and Departure for Points and Degrees.

THESE Tables are of very extensive use in Navigation, affording an easy and expeditious method of solving all problems in right-angled plane trigonometry, and consequently applicable to the various sailings, but particularly useful in working a traverse, whence they obtain the name of *Traverse Tables.*

Table I. contains the difference of latitude and departure (in whole numbers and tenths), answering to distances not exceeding 300, and for courses to every quarter point of the compass. Table II. is of the same nature and extent; but for courses consisting of whole degrees. The courses are set down at the top of the pages when they do not exceed 4 points or 45 degrees, and at the bottom when they are greater than these quantities: the distances are regularly arranged in the columns marked *Dist.;* the first beginning at 1, and ending at 60; the second beginning at 61, and ending at 120, and so on to 300: corresponding to each of these distances, the difference of latitude and departure are set down in adjoining columns, marked *Lat.* and *Dep.:* but it must be carefully observed, that when the course is less than 4 points, or 45 degrees, these must be taken out as marked at the top, and when more, as noted at the bottom of the pages.

Now, the difference of latitude and departure, answering to any given course and distance, being found opposite the distance in that page of the table which contains the course; if, therefore, any two of the four parts, *viz.* the course, distance, difference of latitude, and departure, be given, and those two be found together in the tables, the other two parts will be found in their respective places on the same page. In like manner, the parts of any right-angled plane triangle may be found (provided two of them, exclusive of the right angle, be given), by taking out the hypothenuse as a *Distance,* the perpendicular in a *Lat.* column, the base in the *Dep.* column, and the angle opposite to it as a course. Hence, when these tables are applied in parallel or middle latitude sailing, the co. lat. or co. mid. lat. is taken as a course, the departure or meridional distance is found in the *Dep.* column, and the difference of longitude in the *Dist.* column: in Mercator's sailing, the meridional difference of latitude is taken out in the *Lat.* column, and difference of longitude in the *Dep.* column.

When any of the given parts (excepting the course, which is never to be multiplied or divided) exceed the limits of the table, any aliquot part, as a half, third, fourth, &c. is to be taken; and those found corresponding are to be doubled, trebled, &c., that is, multiplied by the same figure that the given number is divided by.

TABLE III.

Meridional Parts.

This table is used in resolving problems by Mercator's sailing, and in constructing charts on Mercator's projection. The meridional parts are to be taken out for the degrees answering to the given latitude at the top or bottom, and for the minutes at either side column. Thus, the meridional parts corresponding to the latitude 49° 57′ are 3470.

TABLE III*.

To correct the mean Refraction.

The refractions contained in Table IV. being adapted to a mean state of the atmosphere, that is, when the thermometer stands at 50°, and the barometer at 29. 6 inches, if it deviate from this weight and temperature, and accuracy be required, it will be necessary, especially in low altitudes, to correct the mean refraction by the seconds contained in this table, which are to be taken out with the apparent altitude in the side column, and the heights of the thermometer and barometer at the top and bottom, to be added or subtracted as expressed at the top or bottom of the respective columns.

Example. Let the apparent altitude be 5°, the height of the thermometer 74°, and that of the barometer 30. 0 inches: required the true refraction.

Mean refraction by Table IV. to 5° altitude		9′ 54″
Correction for altitude 5°, and 74° height of thermometer...	− 33″	− 24
Ditto for altitude 5°, and 30. 0 height of barometer ...	+ 9	
True refraction required		9 30

TABLE IV.

Mean Refraction.

This table contains the refraction of the heavenly bodies, in minutes and seconds, at a mean state of the atmosphere, and corresponding to their apparent altitudes. This correction is always to be subtracted from the apparent altitude of the object. *Example.* The mean refraction for the apparent altitude 10° 50′, is 4′ 51″.

TABLE V.

Depression, or Dip of the Horizon.

This correction arises from the elevation of the observer above the surface of the sea, whereby the visible horizon, or that seen by the observer, is below the true; and, consequently, altitudes taken with the quadrant are too great by a quantity to be taken out from this table, opposite the height of the observer's eye in feet, and to be subtracted from altitudes taken by a fore observation, but added to those taken by a back one. *Example.* The dip for 20 feet is 4′ 17″

TABLE VI.

The Sun's Parallax in Altitude.

This correction is to be taken out opposite the sun's altitude, and is always additive. *Example.* The sun's parallax corresponding to 50° of altitude, is 6″.

TABLE VII.

The Moon's Augmentation.

The moon's apparent horizontal semidiameter, as given in the Nautical Almanac, is to be increased by a number of seconds, called the augmentation, taken out from this table, answering nearest to his altitude, in order to give the true apparent semidiameter

TABLE VIII.

Dip of the Sea at different Distances from the Observer.

When that part of the horizon immediately under the sun is obstructed by land, and the observer is nearer the shore than five or six miles, then, if the object be brought down to the line separating the sea and land, the dip will exceed that shewn in Table V., which is calculated for an open and unobstructed horizon, and will increase as the distance from the land diminishes. In this case, the dip is to be taken from the present table, with the height of the eye at the top, and the distance estimated in miles in the side column.

TABLE IX.

To correct the observed Altitude of the Sun's lower limb.

This table is intended to simplify the usual method of correcting the observed altitude of the sun's lower limb, when taken by a fore observation, by shewing the correction at once for the joint effect of the sun's semidiameter, dip of the horizon, refraction, and parallax; and as it does not extend to altitudes less than 5°, the least altitude at which observations can be depended on for their accuracy, the corrections are always additive to the observed altitude of the sun's lower limb. These corrections being computed to minutes and tenths, the tenths may easily be reduced to seconds by multiplying them by six. In this table the sun's semidiameter is assumed at 16 minutes, and its variation from that quantity in each month of the year, given at the bottom of the table, is to be added to, or subtracted from, the correction found in the table, according as the sign + or − is prefixed to it.*

The simplicity of this table will appear sufficiently obvious in the following Examples.

Example I. Suppose the observed altitude of the sun's lower limb, by a fore observation, to be 49° 57′ 30″, in the month of May, and the height of the eye 20 feet: required the true altitude of the sun's centre.

Observed altitude of the sun's lower limb		49°	57′	30″
Correction to altitude 50°, and dip 20 feet	10′.9			
Ditto for variation of sun's semidiameter in May ...	−0.2			
	10.7=+		10	42
True altitude of the sun's centre...		50	8	12

---

* This table was computed by Mr. W. Galbraith, Teacher of Mathematics, at Edinburgh. who kindly presented it to the Author for insertion in the present Work.

Example II. Let the observed altitude of the sun's lower limb, taken in the month of February, be 12° 32′ 15″, and the height of the eye 14 feet: required the true altitude of the sun's centre

Observed altitude of the sun's lower limb		12° 32′ 15″
Correction to altitude 12° 30′ and dip 14 feet	8′.2	
Ditto for variation of sun's semidiameter in February	+0 .2	
	8 .4 =	+ 8 24
True altitude of the sun's centre		12 40 39

TABLE X.

Sun's Declination.

The sun's declination is given in this table in degrees and minutes for the years 1859, 1860, 1861, and 1862, at noon on each day of the year under the meridian of Greenwich; but will answer for several subsequent years, by applying the corrections from Table XII. The table is to be entered with the year and month at the top, and the day in either side column; at the same time it is to be noted whether the declination be North or South, as expressed in each column.

TABLE XI.

To correct the Sun's Declination.

As the sun's declination in Table X. is adapted to the meridian of Greenwich, when the ship is considerably to the eastward or westward of that meridian, it should be corrected by a number of minutes taken from this Table (placed at the bottom of the first and second pages of Table X.) with the declination at the top, and the nearest longitude in the side columns, to be added or subtracted, as directed at the head of the table.

Example. Required the sun's declination at noon on September 17th, 1866, in longitude 108° West.

Sun's declination, from Table X. (decreasing)	2° 17′ North.
Correction for longitude 108°, Table XI., to be subtracted	− 7
Sun's true declination	2 10 North.

TABLE XII.

This table is intended to correct the sun's declination given in Table X. for the change that takes place in periods of four years. The table is to be entered with the period of years in either of the side columns, and the month and nearest day at the top; the minutes of correction there found, are to be added to, or subtracted from, the declination taken from Table X., answering to the number of years, reckoning in periods of four years, prior to that of the given year, as denoted at the head of the column; that is, the correction is to be added when the declination is increasing, or subtracted when decreasing.

Example. Required the sun's declination at noon, on February 19th, 1874 at the meridian of Greenwich.

The year 1874 being a period of 12 years after 1862 find the declination in Table X. for the given day in the year 1862, which is 11° 15′ S.; then enter

Table XII. under the month of February; opposite the period of 12 years, and under the 19th day of the month, will be found the correction 2′, which is to be subtracted from the above declination 11° 15′ S., and the remainder 11° 13′ S. will be the required declination.

TABLE XIII.

The right Ascensions and Declinations of the principal Fixed Stars.[*]

This table contains the mean right ascensions and declinations of 61 of the principal stars, computed for the beginning of the year 1860, with their annual variations in seconds and decimal parts of a second. If their places are required for any time subsequent to the year 1860, the annual variation both in right ascension and declination must be multiplied by the number of years and parts of a year elapsed since that time, and the product will be the variation from the beginning of 1860 to the given time. This variation must always be added to the right ascension for 1860; but the variation in declination is additive or subtractive according as the sign + or − is prefixed to the annual variation; then the sum or remainder will be the right ascension and declination for subsequent years. But if the place of a star be required for any time preceding 1860, the variation in right ascension must be subtracted from that in the table, and the variation in declination applied contrary to the sign set against it.

Example. Required the right ascension and declination of the Star Arcturus in June 1870.

From the beginning of 1860 to June 1870 there are about 10½ years.

	h.	m.	s.
Right ascension of Arcturus (in time) for January 1860............	14	9	17
Annual variation + 2s. 73, multiplied by 10½, gives 28. 66 = ...		+	29
Right ascension of Arcturus for June 1870	14	9	46
	°	′	″
Declination of Arcturus for January 1860............................	19	54	47 N.
Annual variation − 18″.92, multiplied by 10½, gives 198″. 66 or	−	3	19
Declination of Arcturus for June 1870	19	51	28 N.

TABLE XIV.

The Sun's mean right Ascension.

The sun's mean right ascension, contained in this table, is to be taken out with the month at the top, and the day in either side column. It is sufficiently exact for ascertaining the time of an object's passing the meridian, in order to obtain the latitude by its meridian altitude; but when greater accuracy is necessary, recourse must be had to the Nautical Almanac.

---

[*] The Stars in the several Constellations being usually designated by Greek characters, we here give the alphabet, with the names of the letters.

α	Alpha.	ε	Epsilon.	ι	Iota.	ν	Nu.	ρ	Rho.	φ	Phi.
β	Beta.	ζ	Zeta.	κ	Kappa.	ξ	Xi.	σ	Sigma.	χ	Chi.
γ	Gamma.	η	Eta.	λ	Lambda.	ο	Omicron.	τ	Tau.	ψ	Psi.
δ	Delta.	θ	Theta.	μ	Mu.	π	Pi.	υ	Upsilon.	ω	Omega.

TABLE XV.

For correcting the observed Altitude of a fixed Star, to find the true Altitude.

This table contains the correction in minutes and tenths to be subtracted from the observed altitude of a star, in order to obtain its true altitude; being the joint effect of refraction and dip of the horizon.

Example. Required the true altitude of a star, whose observed altitude is 20° 30′; the height of the observer's eye being 24 feet.

Star's observed altitude	20°	30′	0″
Correction opposite to altitude 20°, and under 24 feet, 7′.3 =	—	7	18
Star's true altitude	20	22	42

TABLE XVI.

For reducing the Time of the Moon's Passage over the Meridian of Greenwich, to the Time of its Passage over any other Meridian.

The daily variation of the moon's passing the meridian is the excess of time above 24 hours that elapses till her return to the same; and this is found by taking the difference between her passing the meridian of Greenwich on a given day (from Page IV. of the month in the Nautical Almanac) and the preceding, if the longitude of the place be east, or that and the following, if the longitude be west.

Now as the moon is constantly advancing to the eastward in the heavens, she will therefore pass any meridian to the eastward of Greenwich sooner in the day, or a meridian to the westward later, than she does that of Greenwich, by a certain number of minutes, which is to the daily variation as the given longitude of the place is to 360°; and on this principle the table is constructed.

The table is to be entered with the daily variation to the nearest minute at the top, and the longitude of the place in the left side column; then the minutes corresponding to these being added to the time of the moon's passing the meridian of Greenwich, if the longitude be west, or subtracted if east, the sum or remainder will be the time of her passing the meridian of the place in mean time.

Example. At what time will the moon pass the meridian of Calcutta, in longitude 88° 28′ E., on July 2d, 1866?

Mean time of the moon's passage over the meridian of Greenwich July 2d, by the Nautical Almanac	16h. 0m,
Correction corresponding to daily variation 49m., and long. 88° 28′ E.	— 12
Time of moon's passing the meridian of Calcutta, July 2d	15 48

TABLE XVI.*

For finding the Time of High Water.

This table is to be entered with the moon's semidiameter, (taken from Page III of the month in the Nautical Almanac) or the nearest to it, at the top, and the time of the moon's passage over the meridian, in one of the columns so titled: the correction thus found, which is the effect of the sun's action, in accelerating or retarding the time of high water produced by the attraction of the moon, is to be applied to the time of the moon's passage over the meridian, according as the sign + or − is prefixed to it.

TABLE XVII.

For finding the Latitude by an Altitude of the Polar Star.

This table is to be entered with the right ascension of the meridian at the time of observation; the correction corresponding to which being added to, or subtracted from, the true altitude of the Polar Star, as denoted by the sign + or −, the sum or remainder will give the latitude of the place of observation, which is always North.

The table is calculated particularly for the years 1860, and 1870, but will serve with tolerable accuracy for several subsequent years; the corrections may, however, be found for any other year, as follows: first reducing the right ascension and declination of the star, taken from Table XIII., to the given year.

Find the difference between the right ascension of the meridian and the star's right ascension: if the difference be more than 6 hours, and less than 12 hours, subtract it from 12 hours; if it be more than 12 hours, and less than 18 hours, subtract 12 hours from it; if more than 18 hours, subtract it from 24 hours; and the remainder, in each case, will be the star's distance from the meridian in time, which reduce to degrees by Table XIX. Find the number of degrees at the top or bottom of Table II., as if it were a course, and the complement of the declination, in minutes, as a distance: corresponding to these, in the difference of latitude column, will be the correction required in minutes; this correction added to the star's true altitude, if the difference between the star's right ascension and the right ascension of the meridian be more than 6 hours, and less than 18 hours, or otherwise subtracted, the result will be the latitude of the place of observation.

Example. May 21, 1866, if the true altitude of the Polar Star be 50° 13′ at 10h. 15m. apparent time past noon, what will be the latitude of the place of observation?

The right ascension of the Polar Star, in May, 1866, will be 1h. 9m. 52s., and the declination 88° 35′ 33″ N.; consequently the complement of the declination 1° 24′ 27″, or 84 minutes.

The sun's right ascension, May 21, (Table XIV.)†	3h.	51m.
The time of observation	10	15
Right ascension of the meridian	14	6
Right ascension of the Polar Star	1	10
Difference	12	56
Subtract	12	0
Polar Star's distance from the meridian (XIX.)	0	56=14°.

which taken as a course in Table II., and the co. declination 84 as a distance, give in the lat. column 82 minutes, or 1° 22′, the correction, to be added to 50° 13′, the star's true altitude, because the above difference is between 6 and 18 hours: hence the latitude will be 51° 35′ N.

TABLE XVII.*

Table XVII. being constructed on the principles of Plane Trigonometry, the latitude found by it requires a correction, especially in high latitudes, to be taken from this table, with the approximate latitude at the top, and the right ascension of the meridian in either side column. The corresponding minutes and tenths are always to be added to the approximate latitude deduced from the preceding table.

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† The sun's right ascension will be more correctly taken from the Nautical Almanac.

TABLE XVIII.

Corrections of the apparent Altitudes of the Sun and Stars.

This table contains the correction to be applied to the apparent altitude of the sun or a star, in order to obtain the true altitude, and is also used in clearing distances from the effect of refraction and parallax; the sun's correction being the refraction in altitude diminished by parallax, and the star's correction its refraction only: these are to be taken out with the apparent altitude of the object.—*Example.* The sun's correction, corresponding to the apparent altitude 10° 28′, is 4′ 53″, and the star's correction for the same altitude is 5′ 1″

TABLE XIX.

For reducing Longitude into Time, and the contrary.

This table is intended to facilitate the reduction of degrees, &c. of longitude into time, or of hours, &c. into longitude. The method of using it will best appear by inspecting the following examples.

Example I. Required the time answering to 42° 13′ 42″ of longitude.

Time answering to	42°	0′	0″	is	2h.	48m.	0s.	0th.
Ditto to		13	0	...			52	0
Ditto to			42	...			2	48
Hence the time answering to	42	13	42	...	2	48	54	48

Example II. Required the degrees, &c. corresponding to 7h. 6m. 48s.

Longitude corresponding to	7h.	4m.	0s.	is	106°	0′
Ditto to		2	48	...		42
Hence the longitude corresponding to	7	6	48	..	106	42

Longitude in degrees, &c. may be converted into time, and the contrary, independent of this table, by the following Rules:—

1st. To convert degrees, &c. of longitude into time, multiply the longitude by 4, divide the degrees of the product by 60, and the quotient will be the hours, the remainder minutes, and the other parts of the product seconds, &c. of the corresponding time.

Example. Required the time corresponding to 42° 13′ 42″ of longitude.

42° 13′ 42″
4
60) 168 54 48
2h. 48m. 54s. 48th.

2d. To convert time into degrees, &c. Reduce the hours and minutes into minutes, and divide by 4; then the quotient will be the degrees, minutes, &c. of the corresponding time.

Example Required the degrees, &c. corresponding to 7h. 6m. 48s. of time.

7h. 6m. 48s.
60
4) 426m. 48s.
106° 42′

TABLE XX.

For finding the Distance of terrestrial Objects at Sea.

When the eye is elevated above the surface of the adjacent land or water, we not only see the surrounding objects more distinctly, but also see those which are more remote the higher we advance. Now, although the irregularity of the surface of the land will not admit of any one rule that will give the distance to which objects may be seen at different elevations, yet at sea, where the curvature of the water is uniform, those distances may be easily computed by means of this table, in which the distances are exhibited in nautical miles and decimal parts, answering to the height of the eye, or that of the given remote object, allowance having been made for terrestrial refraction.

Example. Being at the mast head looking out for land, and elevated 130 feet above the surface of the sea, I discovered the top of a light-house in the horizon, whose height above the level of the sea is known to be 300 feet: required my distance from the light-house.

In the table opposite 130 feet is	13. 1 miles.
Ditto 300 feet is	19. 9
Sum gives the distance of the ship from the light-house	33. 0

TABLE XXI.

For reducing the Sun's Declination to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

This table contains the corrections to be applied to the sun's declination as given in the Nautical Almanac, which is computed for apparent or mean noon at Greenwich, when it is required for noon at any other meridian, or to any given time at the meridian of Greenwich: it is to be entered with the declination for noon of the given day, as found in Page I. or II. of the Nautical Almanac, at the top, and the longitude of the place, or time at Greenwich, in the side columns; corresponding to these will be found the minutes and seconds to be applied to the above declination, by addition or subtraction, as directed at the head of the table; that is, when the declination is *increasing*, the correction is to be added in west longitude, but to be subtracted in east longitude, or to be added for Greenwich time; but when the declination is *decreasing*, the correction is to be subtracted in west longitude, but to be added in east longitude, or to be subtracted for Greenwich time.

When the declination and longitude, or time at Greenwich, are not nearly found in the table, proportional parts may be used.

When the given time at the meridian of Greenwich exceeds 12 hours, the correction must be taken out at twice, as in Example III.

It must be observed, that this table is subject to an error of a few seconds, from the sun's unequal motion in the ecliptic; but it is nevertheless in general sufficiently exact for observations taken at sea.*

Example I. Required the sun's declination at apparent noon on Sept. 18th, 1866, in longitude 105° 15′ West.

Sun's dec. at apparent noon, by Page I. N. A. (decreasing)...	1° 51′ 47″ N.
Correction for longitude 105° 15′ W.	− 6 51
Sun's declination when passing the meridian of the given place	1 44 56 N.

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* When the sun's declination or right ascension is required to the nearest second, the proportional part of the daily variation may be readily found by logarithms. *See* Explanation and Use of Table XXXIII.

Example II. Required the sun's declination on June 2d, 1866, at 4h. 24m. apparent time at Greenwich.

Sun's dec. June 2, at app. noon, by Page I. N. A. (increasing).	22° 11′ 52″ N.
Correction for 4h. 24m. apparent time	+ 1 25
Sun's declination at Greenwich time	22 13 17 N.

Example III. Required the sun's declination, Oct. 17th, 1866, at 15h. 36m. mean time at Greenwich.

Sun's declination, Oct. 17, at mean noon, by Page II. of the Nautical Almanac (increasing)	9° 16′ 28″ S.
Correction for 12 hours...... + 10′ 54″ Ditto for 3h. 36m....... + 3 16	+ 14 10
Sun's declination at Greenwich time	9 30 38 S.

It will sometimes happen, when the sun is near the Equinoxes, that the correction for longitude, or Greenwich time, will exceed the declination: in this case, if the correction be subtractive, the declination is to be taken from it, and the remainder will be the reduced declination, of a contrary name to that taken from the Almanac.

Example IV. What will be the sun's declination on March 20th, 1866, at 21h. 48m. mean time at Greenwich?

Sun's declination, March 20, at mean noon, by Page II. of the Nautical Almanac (decreasing)	0° 7′ 41″ S.
Correction for 12 hours...... − 11′ 46″ Ditto for 9h. 48m....... − 9 37	− 21 23
Sun's declination at Greenwich time	0 13 42 N.

TABLE XXII.

For reducing the Sun's Right Ascension to any Time at the Meridian of Greenwich.

By this table the sun's right ascension, taken out for noon of the given day, from Page I. or II. of the Nautical Almanac, according as the given time is apparent or mean, may be reduced to any given time at the meridian of Greenwich. It is to be entered with the right ascension at the top, and the Greenwich time in one of the side columns; the correction corresponding to the time being always *added* to the right ascension at the preceding noon: the sum will be the sun's right ascension at Greenwich time.

Example I. Required the sun's right ascension, May 9th, 1866, at 5h. 36m. apparent time at Greenwich.

Sun's right ascen. May 9, at app. noon, by Page I. of the N. A. ...	3h. 4m. 31s.
Correction for 5h. 36m..	+ 54
Sun's right ascension at Greenwich time	3 5 25

Example II. What will be the sun's right ascension on October 10th, 1866, at 10h. 50m. mean time at Greenwich?

Sun's right ascen. Oct. 10, at mean noon, by Page II. of the N.A...	13h. 2m. 28s.
Correction for 10h. 50m.	+ 1 39
Sun's right ascension at Greenwich time	13 4 7

EXAMPLE III. Required the sun's right ascension on July 13th, 1866, at 14h. 10m. mean time at Greenwich.

Sun's right ascension, July 13th, at mean noon, by Page II. of the Nautical Almanac		7h.	29m.	58s.
Correction for 12 hours......	+ 2m. 1s.	+	2	23
Ditto 2h. 10m.......	+ 0 22			
Sun's right ascension at Greenwich time		7	32	21

TABLE XXIII.

Logarithmic Sines, Tangents, and Secants, &c. to every Point and Quarter-Point of the Compass.

This table is useful when the logarithmic sine, tangent, or secant of a ship's course is required to points, or quarter-points, of the compass: it is to be entered with the points in the left side column, when they do not exceed 4, and the names at the top; but when they are above that quantity, the points are to be taken from the right side column, and the names from the bottom.

EXAMPLES.

The log. sine of 3 points is	9.744739
The log. tangent of 6 points is	10.382776

TABLE XXIV.

Logarithms of Numbers.

This table contains the decimal parts of the logarithms of numbers to six places of figures; but as in most of the calculations which occur in navigation, five places are sufficient, it must be observed, that when the sixth figure is omitted, if it be 5 or above, the preceding or fifth is to be increased by 1; thus the logarithm .966986, when taken out to five places only, will be .96699.

A logarithm consists of two parts, which are separated by a point; that on the left hand of the point is called the *index;* the figures on the right hand are the *decimal part;* and as it is the latter only that is inserted in the table, the index must be supplied according to the following rules:—

The index of a logarithm is always one less than the number of figures in the whole number: hence the index of 125 is 2, being one less than the number of figures contained in 125; also 2 is the index of 162.5; for although here are four figures, yet only three of them belong to the whole number, the .5 being a decimal figure. *If the natural number consist of decimal figures only, the index is 9 lessened by the number of ciphers before the first decimal figure:* thus the index of .0051 is 7, being 9 lessened by 2, the number of ciphers before the first decimal figure; the index of .00025 is 6, because there are three ciphers before the first decimal figure.

To find the Logarithm of a natural Number.

If the number consist of one or two figures only. Enter the first page of the table, and in one of the columns marked No. look for the given number; opposite to this, in the column marked Log., will be found the logarithm required, to which prefix the index according to the above directions: thus the logarithm of 56 is found to be 1.748188, the logarithm of 94 is 1.973128, and of .0025 is 7.397940

If the number consist of three figures. Find the given number in the left-hand column of the table, and opposite, in the column marked 0 at the top or bottom, will be the logarithm required, to which prefix the index as before: thus the log. of 295 is 2.469822, of 1.76 is 0.245513, and of .0542 is 8.733999.

When the number consists of four figures. Look for the first three figures in the left side column (without attending to the decimal point, if there be any), and opposite to these, in the column marked with the fourth figure at the top or bottom, is the logarithm required: thus the logarithm of 1246 is 3.095518, of 17.95 is 1.254064, and of .2678 is 9.427811.

If the number consist of five or more figures. Find the logarithm of the first four figures, as before directed; then multiply the number found opposite in the right-hand column under *diff.* (which is the difference between two adjacent logarithms) by the remaining figures; point off from the product as many figures from the right as the multiplier consists of, and those remaining being added to the logarithm of the first four figures, the sum will be the logarithm required, to which prefix the index. If the figures pointed off to the right hand exceed a half, the unit figure of the remainder is to be increased by one.—*Example.* Required the logarithm of 25047. First look in the left side column for 250; opposite to this, in the column with 4 at the top, is the logarithm 398634, and in the right side column the diff. 173; this multiplied by 7, the fifth figure, gives 1211; from which cut off the last figure, and the remainder 121 added to 398634 will give, with the index prefixed, 4.398755, the logarithm required. In this manner the logarithm of 598765 will be found 5.777256.

To find the natural Number corresponding to a given Logarithm.

If the number be required only to four figures. Look in the table for the logarithm nearest to that given, opposite to which will be found the first three figures in the left side column, and the fourth figure at the top or bottom; the decimal point is then to be placed so that the whole number may contain *one figure more than that expressed by the index.* Suppose, for example, the natural number corresponding to the logarithm 2.326929 be required: the nearest logarithm to this is 326950, opposite to which is 212 in the left column, and 3 at the top, which, placed after the first three figures, and the decimal point fixed according to the index, will give 212.3, the natural number required.

If the number be required to five or more figures. Find the logarithm next less to the given one, which will give the first four figures; then take the difference between that and the given logarithm, to which annex as many ciphers as there are figures wanted above four; divide this by the difference found opposite the nearest less logarithm, and the quotient will be the remaining figures required.

For example—To find the natural number corresponding to the logarithm 4.478309 to five figures: the nearest less logarithm is 478278, answering to the number 3008, and the difference between that and the given logarithm is 31; to this annex a cipher, and divide by the difference 145, the quotient will be 2; therefore the number required is 30082. In the same way the natural number corresponding to the logarithm 5.497646 to six figures is 314518.

When the given logarithm consists of only five places of figures, add a cipher to the fifth figure, and proceed as before.

If the number required is to consist altogether of decimal figures, the same method must be used to obtain it as shewn above; only observe that 9 ciphers lessened by the value of the index are to be prefixed to the number found. Thus the number answering to the logarithm 7.819083 is .006593.

To find the Arithmetical Complement of a Logarithm.

The arithmetical complement of a logarithm is the number it wants of 10.000000 or 20.000000; and the easiest way to find it is, beginning at the left hand, to subtract every figure from 9, except the last significant figure, which is to be taken from 10; but if the index exceed 9, it is to be taken from 19. Thus the arithmetical complement of 4.478309 is 5.521691, and of 10.935547 is 9.064453: it is frequently used in the Rule of Proportion, and trigonometrical calculations, to change subtractions into additions.

Here follow a few examples to further illustrate the preceding rules.

	Nat. Num.		Logarithms.
Given	56	to find	1.748188
	1.79	...	0.252853
	98.76	...	1.994581
	596.84	...	2.775858
	.36875	...	9.566732
	156795	...	5.195333

	Logarithms.		Nat. Num.
Given	1.369772	to find	23.43
	2.456366	...	286.0
	3.567439	...	3693.5
	9.876542	...	.75256
	5.123562	...	132911
	4.397625	...	24981.9

TABLE XXV.

Logarithmic Sines, Tangents, and Secants.

This table contains the logarithmic, or, as they are sometimes called, the artificial sines, tangents, and secants, to each degree and minute of the quadrant, with their complements or co-sines, co-tangents, and co-secants, to six places of figures, besides the index; but it may be observed, as of the last table, that five places being generally sufficient in the common practice of navigation, when the sixth is omitted, and it is 5 or above, the preceding or fifth figure is to be increased by a unit.

To find the Logarithmic Sine, Co-sine, &c. of any given Arc in Degrees and Minutes.

If the given degrees be under 45, they are to be taken from the top, and the minutes from the left side column; opposite to which, in that column with the name of the logarithm at top, will be found the required logarithm. But if the degrees be more than 45, they will be found at the bottom of the page, and the minutes in the right side column; likewise the name of the logarithm is to be taken from the bottom of the page.

When the given degrees exceed 90, they are to be subtracted from 180 degrees, and the logarithm of the remainder taken out, as before. Or the logarithmic sine, tangent, &c. of an arc more than 90 is the logarithmic co-sine, co-tangent, &c. of its excess above 90 degrees.

EXAMPLES.

	°	′		Log. to 6 places.		Log. to 5 places.
Required the log. sine of	36	32	...	9.774729	...	9.77473
co-sine of...............	61	18	...	9.681443	...	9.68144
tangent of	54	17	...	10.143263	...	10.14326
co-tangent of	42	50	...	10.032877	...	10.03288
secant of...............	19	27	...	10.025519	...	10.02552
co-secant of...........	70	33	...	10.025519	...	10.02552
sine of	108	36	...	9.976702	...	9.97670
or sine of	71	24				
or co-sine of...............	18	36				

To find the Arc in Degrees and Minutes nearest corresponding to a given Logarithmic Sine, Co-sine, &c.

Look in the column marked at the top or bottom with the name of the given logarithm, and, when the nearest to it is found, the corresponding degrees and minutes will be those required; observing that, when the name is at the top of the column, the degrees are to be taken from the top, and the minutes from the left side column; but if the name be at the bottom, the corresponding degrees will be there likewise, and the minutes in the right side column.

Examples. Required the arcs in degrees and minutes corresponding to the

Log. sine............	9.265390	...	10°	37′
Co-sine	9.528461	...	70	16
Tangent	9.70156	...	26	42
Secant	10.25413	...	56	9

The arcs to logarithmic sines, &c. taken out to degrees and minutes only, are in general sufficiently accurate; but in some of the more rigid astronomical calculations, such as clearing the distance in lunar observations, rating chronometers, &c. it is frequently necessary to take them out to the nearest second· when this is the case, they are to be found in the following manner.

To find the Logarithmic Sine, Tangent, Secant, &c. answering to an Arc of any given Number of Degrees, Minutes, and Seconds.

Find the log. sine, &c. answering to the given degrees and minutes, as above, and take out from the proper column the difference of the adjacent logarithms to 100 seconds (marked at the top Diff. or D.); multiply this difference by the given seconds, and point off the two right-hand figures in the product; then those remaining being added to the log. sine, tangent, or secant of the given degrees and minutes, or subtracted from the log. co-sine, co-tangent, or co-secant, will give the logarithm required.

The differences to the sines and co-sines are set down on the right of their respective columns: the differences to the tangents and co-tangents, being the same, are placed between them; and the differences to the secants and co-secants, being the same as those to the co-sines and sines, are to be taken from the columns corresponding to the latter.

Example I. Required the log. sine of 32° 21′ 45″.

The logarithmic sine of 32° 21′ is..	9.728427
The difference corresponding to the log. sine of the given degrees and minutes is 332; this multiplied by 45 (the number of seconds) pointing off two figures, is....................................	+ 149
Sum is the log. sine required	9.728576

Example II. Required the log. co-sine of 71° 40′ 25″.

The logarithmic co-sine of 71° 40′ is	9.497682
The difference corresponding to the log. co-sine of the given degrees and minutes is 636; this, multiplied by 25, gives	− 159
Remainder is the log. co-sine required.....................	9.497523

Example III. Required the log. tangent of 56° 42′ 20″.

The logarithmic tangent of 56° 42′ is	10.182516
The corresponding difference 459, multiplied by 20, gives	+ 92
Sum gives the log. tangent required	10.182608

Example IV. Required the log. co-secant of 65° 18′ 23′.

The logarithmic co-secant of 65° 18′ is	10.041671
The difference corresponding to the sine of the given degrees and minutes is 97, which, multiplied by 23, gives	− 22
Remainder is the log. co-secant required....................	10.041649

The logarithmic sines and tangents varying by great differences near the beginning and end of the quadrant, it has been thought proper, for the sake of accuracy, to give them for the first and second degrees to every 10 seconds, with their differences between the columns of sines and tangents: when, therefore. the log. sine or tangent of an arc less than 2 degrees be required to the nearest second, it is to be taken out to the next less tenth second, and the opposite difference multiplied by the unit seconds; then the product, cutting off one figure to the right, is to be added as before. As the sine and tangent of an arc is the co-sine and co-tangent of the complement of that arc, the latter may be found when above 88 degrees in a similar way, taking the degrees from the bottom, and the minutes and nearest less tenth second from the right side column. and observing to subtract the proportional part.

Fxample V. Required the log sine of 1° 14′ 43″.

The logarithmic sine of 1° 14′ 40″ is	8.336819
The corresponding diff. 968, multiplied by 3, gives	+ 290
Sum is the log. sine required	8.337109

Example VI. Required the log. co-sine of 89° 21′ 25″.

The logarithmic co-sine of 89° 21′ 20″ is	8.051054
The corresponding diff. 1876, multiplied by 5, gives	— 938
Remainder is the log. co-sine required	8.050116

To find the Degrees, Minutes, and Seconds of an Arc, answering to a given Logarithmic Sine, Co-sine, &c.

Find the logarithm next less to the given one, if it be a sine, tangent, or secant, or next greater, if a co-sine, co-tangent, or co-secant, and note the corresponding degrees and minutes; then take the difference between the logarithm thus found and the given one, to which add two ciphers, and divide that number by the difference of 100″: the quotient will be the seconds to be annexed to the degrees and minutes before found.

Example I Required the degrees, minutes, and seconds corresponding to the log. sine 9.695476.

The log. sine next less to that given is 9.695450, answering to 29° 44′; the difference between this logarithm and the given one is 26, which, with two ciphers added, makes 2600, and this divided by 368, the difference to 100″, gives the quotient 7″ to be annexed to 29° 44′: hence 29° 44′ 7″ are the required degrees, minutes, and seconds.

Example II. Required the degrees, minutes, and seconds answering to the log. co-sine 9.566797.

The log. co-sine next greater to that given is 9.566951, to which answers 68° 21′; the difference between this logarithm and the given one is 154, which, with two ciphers added, makes 15400; this divided by 531, the difference to 100″, gives the quotient 29″ to be annexed to 68° 21′: hence 68° 21′ 29″ are the required degrees, minutes, and seconds.

But if the logarithm next less or greater than the given one should be found in the first six pages of the table, it will point out the degrees, minutes, and nearest less tenth second; then, to find the unit seconds, annex but one cipher to the difference found as before, and divide by the difference in the column marked Diff.

Example. Required the degrees, minutes, and seconds answering to the log sine 8. 421604.

Here the next less logarithm is 8. 421123, answering to 1° 30′ 40″: now the difference between this log. and the given one, with one cipher annexed, is 4810, which, divided by the difference 798, gives 6″; hence 1° 30′ 46″ are the degrees, &c. required.

TABLE XXVI.

Natural Sines.

In this table the natural sines are exhibited to every degree and minute of the quadrant, and arranged so that the degrees corresponding to the sines are to be taken from the top of the page, with their minutes in the left side columns; and the degrees answering to the co-sines, from the bottom, with their minutes in the right side columns: moreover, as they are given to six places of figures, the same rule with respect to the fifth figure must be observed when five only are required, as mentioned in the explanation of the two preceding tables.

The natural sine or co-sine of any number of degrees, &c. more than 90, is the same as the natural sine or co-sine of its supplement, found by subtracting them from 180°; or the natural sine or co-sine of an arc greater than 90°, is the natural co-sine or sine of its excess above 90°.

To find the Natural Sine or Co-sine of a given Arc to any Number of Degrees, Minutes, and Seconds;

Or, to find the Degrees, Minutes, and Seconds of an Arc, corresponding to a given Natural Sine or Co-sine.

These are to be found as directed for the logarithmic sines, &c., except that the differences to 100″ are to be taken from the bottom of that column containing the given degrees in the former case, or the nearest natural sine or co-sine in the latter.

Example I. Required the natural sine of 32° 21′ 45″, or its supplement 147° 38′ 15″.

The natural sine of 32° 21′ is	535090
The difference at the bottom of the column containing the natural sine of the given degrees and minutes is 409; this multiplied by 45, pointing off two figures in the product, gives	+ 184
Sum is the natural sine required	535274

Example II. Required the natural co-sine of 71° 40′ 25″, or 108° 19′ 35″.

The natural co-sine of 71° 40′ is	314545
The difference 460, multiplied by 25, pointing off two figures, gives	− 115
Remainder is the natural co-sine required	314430

Example III. Required the degrees, minutes, and seconds answering to the natural sine 495994.

The natural sine next less to that given is 495964, answering to 29° 44′; the difference between this natural sine and the given one is 30, to which two ciphers being added, and that divided by 422, the difference at the bottom of the column, gives the quotient 7″ to be annexed to 29° 44′: hence 29° 44′ 7″, or its supplement 150° 15′ 53″, are the degrees, &c. required.

Example IV. Required the degrees, minutes, and seconds answering to the natural co-sine 368805.

The natural co-sine next greater to that given is 368936, to which answer 68° 21′; the difference between this natural sine and the given one is 131, to which two ciphers being added, and that divided by 451, the difference found at the bottom of the column, gives the quotient 29″. Hence 68° 21′ 29″, or its supplement 111° 38′ 31″, are the degrees, &c. required.

TABLES XXVII. XXVIII. XXIX.

Logarithmic Solar Tables.

These tables are calculated expressly for the purpose of finding the latitude by two altitudes of the sun and the elapsed time; but the last is applied to several other problems in nautical astronomy.

These tables are to be entered with the hour at the top of the page, the minutes in the left-hand column, and nearest less fifth second at the top of the respective columns. The proportional parts for the remaining seconds are to be taken from the right-hand marginal columns, from those opposite to the logarithms taken from the body of the table: hence the time answering to the given logarithm, and the contrary, may be readily found to the nearest second, as will appear obvious by the following examples.

Example I. Required the logarithm answering to the half-elapsed time 1h. 29m. 20s.

In Table XXVII., and in the page with 1 hour at the top, opposite 29 minutes, and in the column marked with 20s at the top, will be found 0. 42022, the logarithm required.

Example II. Required the log. half-elapsed time answering to 1h. 17m. 28s

The log. half-elapsed time (Table XXVII.) answering to 1h. 17m. 25s. is	0. 47964
Proportional part for the remaining 3s., subtractive, because the logarithms are decreasing	− 27
The log. half-elapsed time corresponding to 1h. 17m. 28s.	0.47937

Example III. Required the time answering to the log. middle time 4.92784.

Log. middle time next less (Table XXVIII.) corresponding to 1h. 40m. 10s. is	4. 92765
Given log. middle time	4. 92784
Difference	19

In the column of proportional parts opposite the nearest less log., the number 20 being the nearest to 19, the above difference, gives 3s.: hence the middle time required is 1h. 40m. 13s.

Example IV. Required the log. rising of 2h. 55m. 43s.

The log. rising of 2h. 55m. 40s. (Table XXIX.) is	4. 44662
The proportional part for 3 seconds, found in the right-hand column nearly opposite the above log. is	+ 23
Hence the log. rising of 2h. 55m. 43s.	4. 44685

Example V. Required the time corresponding to the log. rising 4. 73494.

The given log. rising is	4. 73494
The log. rising next less, corresponding to 4h. 11m. 15s., is	4. 73488
Difference	6

In the right-hand column, opposite the above log., the nearest proportional part is 5, which gives 1 second: this added to 4h. 11m. 15s., the time answering to the next less log., gives 4h. 11m. 16s., the time required.

It is necessary to notice, that the indices in these tables sometimes change in the columns where they could not be inserted, for want of room; this may, however, easily be known by observing that the first figure of the decimal part of the logarithms change from 9 to 0; for instance, the log. rising of 0h. 32m. 25s. is 2. 99942, but that of 0h. 32m. 30s. is 3. 00164. This change of the indices is also pointed out by both indices being shewn as a fraction in the left side column of the logarithms, as, in this instance, by $\frac{2}{3}$.

Example VI. Required the log. rising of 1h. 43m. 24s

The log. rising of 1h. 43m. 20s. is	3. 99972
The proportional part for 4 seconds, found in the right-hand column nearly opposite the above log., is	+ 56
Hence the log. rising of 1h. 43m. 24s. is	4. 00028

In these tables, the logarithms for the first ten minutes of time varying by great differences, the proportional parts for the intermediate seconds could not be inserted: they must, therefore, if required, be found by the Rule of Proportion

TABLE XXX.

Correction of the Moon's apparent Altitude.

This table, which is placed on *left-hand* pages, contains the correction to be added to the moon's apparent altitude in order to obtain the true, being the parallax in altitude lessened by refraction, the former of which makes the moon appear lower, and the latter higher, than her true place: this correction is likewise used in reducing the moon's apparent distance from the sun, a star, or planet, to the true. The table is to be entered with the moon's apparent altitude to the nearest less tenth minute in the left side column, and the minutes of horizontal parallax at the top; the parts for the unit minutes of altitude may be found at the bottom of the first page, but are to be taken from the right-hand columns of the other pages, observing that when the altitude is less than 10 degrees, to take the parts out with the nearest less tenth minute of altitude at the side, and the unit minutes at the top. The parts answering to seconds of parallax are to be taken from the right-hand part of the table, entitled at the top "Add for Sec. of Par.", in that compartment where the first correction was taken, opposite the nearest less tenth second, and under the unit seconds. These parts are both additive.

Example I. Required the correction corresponding to the moon's apparent altitude 33° 44′, and horizontal parallax 56′ 57″.

Correction for moon's altitude 33° 40′, and horizontal parallax 56′	45′	1″
Parts for 4′ of moon's altitude	+	8
Ditto for 57″ of horizontal parallax	+	48
Moon's correction required	45	57

Example II. Let the moon's apparent altitude be 8° 36′, and horizontal parallax 53′ 40″; required the corresponding correction.

Correction for moon's altitude 8° 30′, and horizontal parallax 53′		46′ 17″
Parts for 6′ of moon's altitude	+	3
Ditto for 40″ of horizontal parallax	+	40
Moon's correction required		47 0

Example III. Required the moon's correction answering to the apparent altitude 64° 20′, and horizontal parallax 61′ 16″.

Correction for moon's altitude 64° 20′, and horizontal parallax 61′		25′ 48″
Parts for 0′ of moon's altitude	+	10
Ditto for 16″ of horizontal parallax	+	7
Moon's correction required		26 5

The correction of the moon's apparent altitude may be found independent of this table, by adding together the log secant of the apparent altitude (rejecting 10 in the index) and the proportional logarithm (XXXIV.) of the horizontal parallax; the sum of these will be the proportional logarithm of the parallax in altitude, from which subtract the refraction (taken from Table IV.) answering to the apparent altitude, and the remainder will be the moon's correction.

The first example will be thus worked:—

Moon's apparent altitude		33° 44′	Secant	0.0801
Moon's horizontal parallax		56′ 57″	Prop. Log.	0.4998
Moon's parallax in altitude	+	47′ 22″	Prop. Log.	0.5799
Refraction (Table IV.)	—	1 25		
Moon's correction	+	45 57		

TABLE XXX.*

Auxiliary Arcs.

This Table of Auxiliary Arcs is employed in finding the true distance by Method I.; and as it is arranged similar to Table XXX., it is placed on the *right-hand* pages, opposite to the same arguments as in that table.

The arcs are to be taken out with the moon's apparent altitude to the next less tenth minute in the left side column, opposite to which, in the column with the minutes of the moon's horizontal parallax at the top, will be found a corresponding arc in minutes and seconds, to which always prefix 60°; the parts for the unit minutes of the moon's apparent altitude are found at the bottom of the page, and for the seconds of parallax in the right-hand part of the table, similar to those in Table XXX. A correction for the sun or star's altitude is to be taken from the marginal column on the right hand; but when the distance of the moon from a planet is observed, the correction is to be taken from Table L. All these corrections are additive.

Example I. Required the auxiliary arc corresponding to the moon's apparent altitude 33° 44′, the moon's horizontal parallax 56′ 57″, and the sun's apparent altitude 10°.

Arc corresponding to alt. 33° 40′, and horizontal parallax 56′		60° 16′ 59″
Parts for 4′ of moon's altitude	+	2
Ditto for 57″ of horizontal parallax	+	19
Ditto for sun's apparent altitude 10°	+	2
Auxiliary arc required		60 17 22

Example II. Required the auxiliary arc corresponding to the moon's apparent altitude 8° 36′, the moon's horizontal parallax 53′ 40″, and a star's apparent altitude 10°.

Arc corresponding to moon's alt. 8° 30′, and hor. parallax 53′	60°	3′	37″
Parts for 6′ of moon's altitude		+	3
Ditto for 40″ of horizontal parallax		+	4
Ditto for star's altitude 10°		+	1
Auxiliary arc required	60	3	45

Example III. Required the auxiliary arc corresponding to the moon's apparent altitude 48° 37′, the moon's horizontal parallax 58′ 32″, a planet's apparent altitude 21°, and horizontal parallax 18″.

Arc corresponding to moon's alt. 48° 30′, and hor. parallax 58′	60°	24′	4″
Parts for 7′ of moon's altitude		+	3
Ditto for 32″ of horizontal parallax		+	14
Ditto for planet's altitude 21°, and hor. parallax 18″ (Table L.)		+	4
Auxiliary arc required	60	24	25

TABLES XXXI. XXXII.

Logarithms for finding the Apparent Time or Horary Angle.

The logarithms in these tables are intended to facilitate the computation of time, deduced from the altitude of a celestial object; they are arranged in the same manner as those in Tables XXVII., XXVIII., and XXIX., and therefore their corresponding times are to be found in the same manner as in those tables.

Example. Required the time corresponding to the logarithm 9.24864.

The given logarithm	9.24864
The logarithm in the table next less to the above, corresponding to 3h. 19m. 10s. is	9.24850
Difference	14

In the column of proportional parts opposite the nearest less logarithm, the difference 14 gives 2s.; therefore the time corresponding to the given logarithm is 3h. 19m. 12s.

TABLE XXXIII.

Logarithms for finding the Correction to reduce the Sun's Declination, Right Ascension, &c. to any Time under the Meridian of Greenwich.

By this table the proportional part of the daily change of the sun's declination, right ascension, or any other elements that are given in the Nautical Almanac, for intervals of 24 hours, may be found to the nearest second. The numbers at the head of the columns may be considered either as hours, degrees, or minutes, and those in the side columns must be taken as minutes or seconds accordingly.

To find the proportional part corresponding to any given time at Greenwich, add together the logs. of the daily variation and of the Greenwich time; their sum will be the log. of the proportional part of the change in 24 hours, to be taken in the same manner as the daily change is found: this proportional part added to, or subtracted from, the declination, &c. at the preceding noon, according as it is increasing or decreasing, the result will be the declination, &c. at the given Greenwich time.

EXAMPLE I. Required the Sun's declination and right ascension on Oct. 17th, 1866, at 15h. 36m., mean time at Greenwich.

Sun's declination, Oct. 17, by Page II. of Naut. Alm.	9°	16′	41″	S.	
Ditto, Oct. 18, by Ditto	9	38	36	S.	
Daily variation or change in 24 hours (*increasing*)...		21	55	...Log.	0.0394
Greenwich mean time		15h.	36m.	...Log.	0.1871
Variation or change in 15h. 36m............	+°	14′	15″*	...Log.	0.2265
Sun's declination, Oct. 17, by Page II. of Naut. Alm.	9	16	41	S.	
Ditto at Greenwich mean time	9	30	56	S.	

Sun's right ascension, Oct. 17, by Page II. Naut. Alm.	13h.	28m.	29s.		
Ditto, Oct. 18, by Ditto	13	32	14		
Daily variation or change in 24 hours (*increasing*)...		3	45	...Log.	0.8062
Greenwich mean time		15h.	36m.	...Log.	0.1871
Variation or change in 15h. 36m............	+h.	2m.	26s*	...Log.	0.9933
Sun's right ascension, Oct. 17, by Page II. of Naut. Alm.	13	28	29		
Ditto, at Greenwich mean time......	13	30	55		

EXAMPLE II. Required the right ascension and declination of the Planet Venus, on June 29, 1866, at 11h. 48m. mean time at Greenwich.

Venus's right ascen., June 29, by Page 265, Naut. Alm.	8h.	46m.	36s.		
Ditto, June 30, by Ditto ...	8	51	29		
Daily variation or change in 24 hours (*increasing*)...		4	53	...Log.	0.6915
Greenwich mean time		11h.	48m.	...Log.	0.3083
Variation or change in 11h. 48m.	+h.	2m.	24s....	*Log.	0.9998
Venus's right ascen., June 29, by Page 265, Naut. Alm.	8	46	36		
Ditto, at Greenwich mean time............	8	49	00		

Venus's declin., June 29, by Page 265, Naut. Alm.	19°	47′	48″	N.	
Ditto, June 30, by Ditto ...	19	28	30	N.	
Daily variation or change in 24 hours (*decreasing*)..		19	18	...Log.	0.0947
Greenwich mean time		11h.	48m.	...Log.	0.3083
Variation or change in 11h. 48m.	−°	9′	29″*	...Log.	0.4030
Venus's declin. June 29, by Page 265, Naut. Alm..	19	47	48	N.	
Ditto, at Greenwich mean time............	19	38	19	N.	

TABLE XXXIV.

Proportional Logarithms.

These logarithms were first calculated by Dr. Maskelyne, in order to facilitate the operation of finding the time at Greenwich, by comparing the observed distance between the moon and the sun, a star, or a planet, when reduced to the true, with those set down in the Nautical Almanac, for every third hour of Greenwich time; and are likewise frequently applied in other calculations where sexagesimals are concerned. The Table is to be entered either with degrees and minutes, or hours and minutes, at the top, and seconds in either side column. Thus the proportional logarithm of 0° 15′ 36″, or 0h. 15m. 36s is 1.0621.

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* Or (if preferred) the proportional part of change in declination and right ascension of the sun and planet *may be computed by the hourly variation*, as given in the Nautical Almanac.

Proportion by logarithms being performed by adding together the arithmetical complement of the logarithm of the first term* to the logarithm of the second and third terms, rejecting 10 from the index; this table may therefore be readily applied in finding the fourth term of a proportion in sexagesimals; as we shall shew in the following examples.

Example I. Suppose the sun's altitude to decrease 51′ in 16m. 23s. of time, how much will it decrease in 8m. 6s.?

As	16m. 23s.	Prop. Log. (Arith. Comp.)	8.9591
Is to	8m. 6s.	Prop. Log.	1.3468
So is	0° 51′	Prop. Log.	.5477
To decrease of alt.	25′ 13″	Prop. Log.	.8536

Example II. Let the altitude of the moon's upper limb, observed at 3h. 28m. 44s. be 20° 3′, and 20° 45′ when taken at 3h. 38m. 20s.; required its altitude at 3h. 33m. 47s.

	h. m. s.		h. m. s.		° ′
Time at first alt.	3 28 44	Time at first alt.	3 28 44	First alt.	20 3
Time at second alt.	3 38 20	Time at req. alt.	3 33 47	Second alt.	20 45
Diff.	9 36	Diff.	5 3	Diff.	0 42

As	9m. 36s.	Prop. Log. (Arith. Comp.)	8.7270
Is to	5m. 3s.	Prop. Log.	1.5520
So is	42′ 0″	Prop. Log.	.6320
To increase of alt.	+ 22′ 6″	Prop. Log.	.9110
First observed alt.	20 3 0		
	20 25 6	Altitude of moon's upper limb at 3h. 33m. 47s.	

TABLE XXXV.

To correct the apparent Distance.

This table contains a correction applied in reducing the apparent to the true distance by the approximate methods. It is to be entered with the distance at the top or bottom, and the moon's correction in altitude and in distance (or second correction) alternately, in the left side column; the difference between the numbers of seconds thus taken out, is to be added to the corrected distance when less than 90°, or subtracted when above.

Example. Required the correction corresponding to the distance 70°, the moon's correction in altitude 36′, and the moon's correction in distance 13′.

In the column with 70° at the top, and opposite 36′ in the side column, is found 4″; again, in the same column, opposite 13′ in the side column, stands 1″; the difference of these two numbers of seconds, viz. 3″, is to be added to the corrected distance, because it is less than 90°.

This table is somewhat altered from the original when the distance is above 90° (the seconds being the complement to 20 of those formerly given), in order to adapt it to an easy and general method of clearing the distance, by Joseph de Mendoza Rios, F. R. S. When his method is used, the seconds are to be taken out with the apparent distance at the top or bottom, and the moon's correction and difference of corrections in the side column.

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* The arithmetical complement of a proportional logarithm is found by subtracting it from 10.0000.

TABLE XXXVI.

Natural Versed and Suversed Sines.

In this table, which is calculated to radius 1.000000, the degrees are given at the top of the pages from 0° to 89°, and from 90° to 180° at the bottom. To each degree there are three columns, marked versed, parts for ″, and *suvers.*, being abbreviations of natural versed sines, proportional parts for seconds of a degree, and supplementary natural versed sines, or suversed sines. In the left columns of the pages are the minutes of the arcs between 0° and 89°, beginning from the top; they also represent seconds in taking out the proportional parts of the versed sines. In the right columns of the pages are the minutes for arcs between 90° and 180°, beginning from the bottom; and they also represent seconds, in taking out proportional parts for suversed sines.*

To find the Natural Versed Sine of a given Arc to the nearest Second.

Find the natural versed sine, in the column of versed, corresponding to the given degrees and minutes, to which add the parts taken from the column of parts for ″, belonging to the given degree, opposite the seconds in the *left* column, and the sum will be the natural versed sine required. When the given arc exceeds 180°, it is to be subtracted from 360°, and the natural versed sine of the remainder will be that required.

Example I. Required the natural versed sine of 65° 14′ 46″.

Under 65° in column of versed, and opposite 14′ in the *left* column, is	.581076
Under 65° in column of parts for ″, and opposite 46″ in the *left* column, is	203
Sum is the natural versed sine of 65° 14′ 46″ required..........................	.581279

Example II. Required the natural versed sine of 142° 38′ 39″, (or 217° 21′ 21″).

Above 142° in column of versed, and opposite 38′ in *right* column, is ...	1.794768
Above 142° in column of parts for ″, and opposite 39″ in *left* column, is	116
Sum is the natural versed sine of 142° 38′ 39″ (or 217° 21′ 21″) required	1.794884

To find the Arc in Degrees, Minutes, and Seconds, corresponding to a given Natural Versed Sine.

In one of the columns of versed find the natural versed sine next less to the given one, and the corresponding degrees and minutes will be those required. Subtract this natural versed sine from the given one, and opposite the remainder taken in the column of parts for ″, belonging to the degree already found, will be the seconds required in the *left* column.

Example I. Required the arc in degrees, minutes, and seconds, corresponding to the natural versed sine 049925.

The given natural versed sine is	.049925
The nearest less natural versed sine is found under 18°, and opposite 10′ in the left column, being	.049846
Difference	79

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[*] This table is arranged similar to one in Mr. Riddle's Navigation, where only the last five decimal figures are inserted.

This difference 79 being found in the column of parts for ″, under 18°, corresponds to 51″ in the *left* column; therefore the arc required is 18° 10′ 51″.

Example II. Required the arc to the nearest second corresponding to the natural versed sine 1.790977.

The given natural versed sine is	1.790977
The nearest less natural versed sine is found above 142°, and opposite 16′ in the *right* column, being	1.790868
Difference	109

The difference 110 being found in the column of parts for ″, above 142°, corresponds to 37′ in the *left* column: hence the required arc is 142° 16′ 37″.

This table is used in clearing the apparent distance of the moon from the sun, a star, or a planet, by Method I. in this Work, where only the *last five decimal figures* are taken out; but as the true distance never differs much more than a degree from the apparent distance, the figures omitted can never lead to error in discriminating to which degree the true distance belongs.

Example. Suppose the apparent distance to be about 74° and the true distance corresponding to the sum of the last five figures of the natural versed sines 15359 be required:

The given sum of the five last figures of natural versed sines is	15359
Under 73°, in the column of versed, and opposite 27′ in the *left* column, is	15148
Difference	211

The difference 210 in the column of parts for ″, under 73°, corresponds to 45″ in the left column; therefore the true distance would be 73° 27′ 45″.

The same figures would also correspond to the arc 102° 26′ 12″; but that cannot be the true distance, as it differs so many degrees from the apparent distance: hence no mistake can arise by employing only the last five figures.

To find the Natural Suversed Sine of a given Arc to the nearest Second.

Add 1 minute to the given arc, and take out the natural suversed sine of the degrees and minutes from the proper column; but the parts for seconds will be found opposite the given seconds in the *right* column, and are to be added to the natural suversed sine of the degrees and minutes.

Example I. Required the natural suversed sine of 25° 19′ 12″.

Under 25° in column of *suvers.*, and opposite 20′ in *left* column, is	1.903834
Under 25° in column of parts for ″, and opposite 12″ in *right* column, is	101
Sum is the natural suversed sine of 25° 19′ 12″ required	1.903935

Example II. Required the natural suversed sine of 164° 18′ 27″.

Above 164° in column of *suvers.*, and opposite 19′ in *right* column, is	.037230
Above 164° in column of parts for ″, and opposite 27″ in *right* column, is	43
Sum is the natural suversed sine of 164° 18′ 27″ required	.037273

TABLE XXXVII.

For reducing Sidereal to Mean Solar Time.

This table is to be entered with the hours, minutes, and seconds of sidereal time, corresponding to which are the minutes, seconds, and hundredths of the acceleration of sidereal on mean time, the parts of which being taken out, and their sum subtracted from the given sidereal time, will convert the same into mean solar time.

Example. Required the mean solar time corresponding to 8h. 25m. 42s. of sidereal time.

8h. of sidereal time gives		1m.	18.64s.
20m.			3.28
5m.			0.82
40s.			0.11
2s			0.01
Acceleration of sidereal on mean time	−	1	22.86
Given sidereal time	8h.	25	42.
Mean solar time required	8	24	19.14

This table is useful when the time of a celestial object's transit over the meridian is noted by a sidereal clock, and it is required to find the corresponding mean time.

TABLE XXXVIII.

For reducing mean Solar Time to Sidereal Time.

The minutes, seconds, and hundredths in the table are to be taken out in the same manner as those in the preceding table, and their parts added to the given mean time.

Example. Required the sidereal time corresponding to the interval 2h. 42m. 50s. measured in mean solar time.

2h. of mean solar time give		0m.	19.71s.
40m.			6.57
2m.			0.33
50s.			0.14
Given mean solar time	2h.	42	50
Required sidereal time	2	43	6.75

If double altitudes of a star be taken to determine the latitude, the elapsed time, measured by a chronometer or watch, is to be reduced to sidereal time, as above; then the computation will be the same as that for finding the latitude by double altitudes of the sun.

TABLE XXXIX.

Logarithmic Difference.

The logarithms in this table are applied in several methods of reducing the apparent to the true distance. They are to be taken out with the given degree of the moon's apparent altitude at the top, and the nearest less tenth second of horizontal parallax in the left side column. The proportional part for the minutes of altitude, which is subtractive, is found by multiplying the difference to 100 minutes, taken out of the right side column opposite the horizontal parallax, by the given minutes, and striking off two figures to the right; that answering to the unit seconds of parallax is found at the bottom part of the page under the given seconds. and is also subtractive. This logarithm is likewise to be further diminished by a number taken from Tables XL. or XLI. corresponding to the sun or star's apparent altitude; or from Table XLIX. when a planet it observed.

Example I. Required the logarithmic difference corresponding to the moon's apparent altitude 71° 29′, the sun's apparent altitude 31° 46′, and the moon's horizontal parallax 54′ 11″.

Log. difference to moon's apparent alt. 71°, and hor. par. 54′ 10″, is		9.993716
The diff. 68 multiplied by 29′, gives the prop. part	— 20	— 32
Proportional part to 1″ of moon's horizontal parallax	— 2	
Correction for sun's apparent altitude 32° (Table XL.) ...	— 10	
Logarithmic difference required..		9.993684

Example II. Required the Logarithmic difference corresponding to the moon's apparent altitude 34° 54′, the star's apparent altitude 18° 26′; and the moon's horizontal parallax 57′ 25″.

Log. difference to moon's apparent alt. 34°, and hor. par. 57′ 20″, is		9.996132
The diff. 172 multiplied by 54′, gives the prop. part	— 93	— 100
Proportional part to 5″ of moon's horizontal parallax......	— 6	
Correction for star's apparent altitude 18° (Table XLI.) .	— 1	
Logarithmic difference required..		9.996032

Example III. Required the logarithmic difference corresponding to the moon's apparent altitude 42° 2′, a planet's apparent altitude 12° 26′, the moon's horizontal parallax 57′ 11″, and the planet's horizontal parallax 15″.

Log. diff. to moon's apparent alt. 42°, and moon's hor. par. 57′ 10″, is		9.995350
The diff. 162 multiplied by 2′, gives the prop. part.........	— 3	— 13
Proportional part to 1″ of moon's horizontal parallax	— 1	
Corr. for planet's app. alt. 12°, and hor. par. 15″ (XLIX.)	— 9	
Logarithmic difference required..		9.995337

TABLE XL. XLI.

To correct the Logarithmic Difference.

These tables are intended to correct the logarithmic difference for the sun or a star's apparent altitude, with which they are to be entered, and the corresponding number subtracted from the logarithmic difference, as shewn above.

TABLE XLII.

Amplitudes.

This table is intended to expedite the method of finding the variation of the compass by comparing the magnetic with the true amplitude: the latter is here taken out by inspection, being given in degrees and minutes, and is to be found with the declination at the top, and the latitude in the left side column. Moreover, when the minutes of the latitude or declination are nearly 30, or half a degree, the mean of the amplitudes found for the two nearest degrees, will give the amplitude required nearly, as shewn in the following examples.

Example I. What is the sun's true amplitude in latitude 51° 31′ N., when the declination is 8°?

True amplitude by Table for latitude 51° and declination 8°	12°	47′
Ditto for latitude 52 and declination 8	13	4
	2)25	51
Sun's true amplitude required	12	55

Example II. Required the sun's true amplitude in latitude 34° 5′, when the declination is 18° 32′.

True amplitude by Table for latitude 34° and declination 18°.........	21°	53′
Ditto for latitude 34 and declination 19	23	7
	2)45	0
Sun's true amplitude required	22	30

Example III. On what points of the horizon does the sun rise and set in latitude 57° 36′ N., when his declination is 18° 28′ S.?

Sun's true amplitude for latitude 57° and declination 18°	34°	34
Ditto for latitude 57 and declination 19	36	43
Ditto for latitude 58 and declination 18	35	40
Ditto for latitude 58 and declination 19	37	54
	4)144	51
Sun's true amplitude required	36	13

Hence the sun rises E. 36° 13′ S., or S. E. ¾ E., and sets W. 36° 13′ S., or S. W. ¾ W.

In the same manner the true amplitude of the moon, planets, or stars may be found when their declination and the latitude are given.

TABLE XLIII.

Semidiurnal and Seminocturnal Arches,
For finding the Time of the Rising and Setting of a Celestial Object.

This table exhibits half the time that a celestial object continues above the horizon when the declination and latitude are of the same name; or below, when they are of contrary names; usually called its semidiurnal and seminocturnal arches, from whence the apparent time of its rising and setting may be computed. These are to be taken out with the latitude in either side column, and the declination at the top; then the angle of meeting will point out the arch required, which, if the object be the sun, will be the apparent time of its setting, when the latitude and declination are of the same name, or of its rising, when they are of contrary names; and this subtracted from 12 hours, will give the apparent time of the sun's rising in the former case, and of its setting in the latter: double the time of his rising will be the length of the night, and double the time of his setting, the length of the day.

Example. Required the apparent time of the sun's rising and setting, with the length of the day and night, in latitude 51° 31′ N., when the declination is 20° N.

The time answering to latitude 51° and declination 20° is	7h	47m.
Ditto to latitude 52 and declination 20 is	7	51
	2)15	38
App. time of the sun's setting, because lat. and declin. are both North	7 12	49
Apparent time of the sun's rising	4	11
Double the rising gives the length of the night in apparent time	8	22
Double the setting gives the length of the day in ditto	15	38

To find the apparent time of a star's rising and setting, subtract the sun's right ascension from the star's right ascension (increasing the star's right ascension by 24 hours, if it be less than the sun's), and the remainder will be the approximate time of the star's passing the meridian*; then the latitude and declination found in the table, will give the time the star takes in ascending from the horizon to the meridian, and descending from the meridian to the horizon, when they are of the same name: therefore, if these hours and minutes be subtracted from the time of its passage over the meridian, the remainder will be the apparent time of its rising; and, if added, the sum will be the time of its setting.

But when the latitude and declination are of contrary names, the time found as above will be half the star's continuance under the horizon; consequently it is to be subtracted from 12 hours, to give half the time of its continuance above the horizon; with which proceed as before.

EXAMPLE 1. At what apparent time does the Star Arcturus rise and set on June 1st, in latitude 51° North?

Star's right ascension by Table XIII.	14h.	9m.	
Sun's right ascension, June 1st, by Table XIV.	4	35	
Approximate time of the star's passing the meridian	9	34	
Time answering to latitude 51° N., and star's declination 20° N., is	7	47	
Remainder gives the time of the star's rising	1	47	
Sum gives the time of the star's setting	17	21	P. M.
Or...	5	21	A. M.

EXAMPLE II. At what apparent time does the Star Regulus rise and set on May 10th, in latitude 33° South?

Star's right ascension by Table XIII.	10h.	1m.	
Sun's right ascension, May 10th, by Table XIV.	3	8	
Approximate time of the star's passing the meridian	6	53	
Time answering to latitude 33° S., and star's declination 13° N., is 6h. 34m., which subtracted from 12 hours, is	5	26	
Remainder gives the time of the star's rising	1	27	
Sum gives the time of the star's setting	12	19	P. M.
Or...	0	19	A M.

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* The time of 60 of the principal stars passing the meridian throughout the year will be found in Table XLIV

NOTE.—If the time of the sun or a star's rising or setting be required in mean time, the equation of time taken from the Nautical Almanac must be applied to the apparent time, found as in the preceding examples.

After the same manner, the mean time of the rising and setting of the planets may be computed, observing to take out their declination and passage over the meridian from pages 251 to 323 of the Nautical Almanac for 1866.

To find the time of the rising and setting of the moon, the time of her passage over the meridian of Greenwich in mean time is to be taken from Page IV. of the month in the Nautical Almanac, to which the minutes from Table XVI. are to be applied, in order to obtain the time of its passing the meridian of the given place; then the semidiurnal arch, found as before, answering to the moon's declination at the time of its passing the meridian (given in Pages V. to XII. of each month in the Nautical Almanac), and the latitude of the place, subtracted from the above reduced time, will give the approximate time of the moon's rising, or, added thereto, will give that of its setting. But as the moon changes her place in the heavens very rapidly, if greater accuracy be required the declination must be taken from the Nautical Almanac corresponding to the approximate time of its rising or setting reduced to Greenwich time; then the semidiurnal arch being again found, and corrected by adding the minutes from Table XVI. corresponding thereto, and the daily variation of her passage over the meridian, the sum, subtracted from, or added to, the reduced passage over the meridian, will give the mean time of her rising or setting very nearly.

EXAMPLE. Required the mean time of the moon's rising at St. Helena, in latitude 15° 55′ S, and longitude 5° 43′ W., on July 27, 1866.

In Page IV. of July in the Nautical Almanac, the time of the moon's passing the meridian of Greenwich is 12h. 18m., to which one minute (the number from Table XVI. answering to the daily variation 50m., and longitude 5° 43′) being added, gives the time of her passing the meridian of St. Helena	12h 19m.
Time answering to latitude 16° S., and moon's declination 14° S.	6 16
Remainder gives the approximate time of moon's rising	6 3
Longitude of St. Helena, in time (Table XIX.)	0 23 W.
Corresponding Greenwich time	6 26

The moon's declination at this time, by Page XI. of July in the Nautical Almanac, is 14° 40′ South.

Time answering to Latitude 16° S., and declination 14° 40′ S.	6h 18m.
Correction from Table XVI. to 6h. 18m., and daily variation 50m. ...	+ 12
Semidiurnal arch corrected	6 30
Reduced time of the moon's passing the meridian........................	12 19
Time of the moon's rising..	5 49

It must be understood that the above methods are only *approximations*, and may deviate two or three minutes from the truth; but it is presumed they will be found sufficiently exact for most nautical purposes.

The semidiurnal and seminocturnal arches may be found independent of this table, by adding together the log. tangents of the given latitude and declination, which sum will be the log. sine of an arch in degrees, &c., to be reduced into time, and increased by six hours.

TABLE XLIV.

To find the Time of the principal Stars passing the Meridian

In this table the apparent times of 61 of the principal stars passing the meridian are given for every fifth day of each month throughout the year, beginning on the first day of each month; and since the stars perform a revolution, or return to the meridian, in 23 hours, 56 minutes, and 4 seconds of mean solar time, that is about 4 minutes earlier every day, when the time of their transit is required for any intermediate day, it may be found by multiplying the number of days, since the preceding one given in the table, by 4, and subtracting the product from the time of the transit on that day: the remainder will then be the apparent time of the transit on the day required. Suppose, for example, we want to know at what time the Star Aldebaran will pass the meridian on February 14th. Now, by the table it appears that the star will pass the meridian on the 11th of that month, at 6h. 46m.; then to find the time of its transit on the 14th, multiply 3, the number of days since the 11th, by 4; the product, 12 minutes, subtracted from 6h. 46m. will give 6h. 34m., the time of the star's passage over the meridian on the 14th February.

The times shewn in the table being only approximations, may deviate two or three minutes from the truth, but will nevertheless be sufficiently exact for the purposes to which they are intended to be applied.

By the assistance of this table, the method of finding the latitude by the meridian altitude of a star will be greatly facilitated; for when we know at what time nearly a star will pass the meridian, and its approximate altitude at that time, there can be no difficulty in making the requisite observation to determine the latitude: these opportunities occur frequently in the course of a clear night, and may be put in practice by any person otherwise unacquainted with the stars in the heavens; which we shall endeavour to explain by a few examples.

In the first place, the altitude of any star when passing the meridian, may be found by adding together the co-latitude of the place of observation, and the declination of the star, when they are of the same name, or taking their difference when of contrary names: the altitude to be reckoned from the South point of the horizon, when the latitude is North, and the contrary when South; but when the sum exceeds 90°, it is to be taken from 180°, and reckoned from the opposite point of the horizon, that is, from the North in North latitude, and from the South in South latitude.

Thus, having the time of the star's transit, or passage over the meridian, by the table, and its meridian altitude nearly by calculation, set the index of the quadrant to that altitude, and a few minutes before the time of the star's transit, direct the sight towards the North or South points of the horizon, as shewn above, and the reflected image of the star will be perceived in the horizon-glass, upon or near the horizon, which being brought into contact with it, and kept so until the star arrive at its greatest or meridian altitude, and the arch read off the quadrant, the correct latitude may be found by calculation.

Example I. Suppose, on the evening of July 6th, the ship being in latitude 36° 30′ N. by account, about nine o'clock, the latitude be required by observing the meridian altitude of a star. Now by the table, the Star Antares will pass the meridian on that day about 9h. 16m.; also by Table XIII. the declination of that star appears to be 26° 5′ S.; therefore from the complement of the latitude 53° 30′ N. subtract the star's declination, because they are of contrary names, and the remainder will give the meridian altitude 27° 25′, to which set the index of the quadrant, and directing the sight to the South point of the horizon, observe the meridian altitude of the Star Antares, and thence deduce the latitude.

There is not the least danger of mistaking the star, as no other will have the same meridian altitude at that time.

Example II. What star will be on the meridian about 5h. A. M. on February 3d, and what will be its meridian altitude, supposing the latitude of the ship to be 15° 40′ N. by account?

By Table XLIV. the Star Arcturus will pass the meridian on February 1st at	17h.	6m.	
Number of days since 2 × 4 =	—	8	
Arcturus will pass the meridian on February 3d at	16	58	P. M.
	12	0	
Or...	4	58	A. M.
Latitude of the ship by account	15°	40′	N.
	90		
Complement of the latitude	74	20	N.
Declination of Arcturus by Table XIII.	19	55	N.
	94	15	
	180		
Meridian altitude of Arcturus from the North point of the horizon	85	45	

When the complement of a star's declination is less than the latitude, of the same name, the star will not rise or set, but pass the meridian below the pole 11h. 58m. after it has passed the meridian above the pole: its altitude being then observed, the latitude may thence be found by rules laid down for that purpose in page 189.

Its meridian, or least altitude at that time, is found by subtracting the complement of the declination from the latitude; which altitude is to be reckoned from the North or South points of the horizon according to the latitude.

Example III. At what time will the Star Dubhe, in Ursa Major, be on the meridian below the pole on December 15th, and what will be its meridian altitude at that time in latitude 45° 40′ N.?

Time of Dubhe's transit above the pole, Dec. 11th, Table XLIV.	17h.	37m.	
Number of days to December 14th, 3 × 4 =	—	12	
Time of Dubhe's transit above the pole, December 14th	17	25	
Half interval of the star's revolution	11	58	
	29	23	
	24		
Time of Dubhe's transit below the pole, December 15th	5	23	P. M.
Declination of Dubhe by Table XIII.	62°	30′	N.
	90		
Complement of the declination	27	30	N.
Latitude	45	40	N.
Meridian altitude of Dubhe below the pole from the North point of the horizon	18	10	

in the Nautical Almanac, which reduce to the time of its passing the meridian of the given place by Table XVI.: then find the corresponding time at Greenwich, as directed in Page 155; and take out the moon's declination from the Nautical Almanac, corresponding to this time.

With the moon's declination, and the latitude of the given place, find the time by the present Table.* Add to this time the minutes corresponding to it, and the moon's daily variation, taken from Table XVI., and subtract the sum from, or add it to, the time of the moon's meridian passage at the given place, according as the observation is to be made before or after it, and the result will be the mean time required, which may be reduced to apparent time, by applying the equation from Page II. of the Nautical Almanac.

Example I. Required the apparent time when the moon will be on the prime vertical, or bear due West, on July 25, 1866, in latitude 34° 56′ S., and longitude 72° East.

Mean time of the moon's meridian passage at Greenwich, July 25, by Page IV. of the Nautical Almanac		10h. 38m.
Corr. for daily variation 50m., and longitude 72° E. (Table XVI.)		— 9
Mean time of the moon's meridian passage at the given place		10 29
Longitude 72° E., in time (Table XIX.)		4 48 E.
Mean time at Greenwich when the moon passes the meridian of the given place		5 41
Mean time of the moon's meridian passage at the given place		10h. 29m.
Time by the Table corresponding to 18° S., (the moon's declination at 5h. 41m. Greenwich mean time, by Page XI. of the Nautical Almanac), and latitude 35° S.	4h. 9m.	4 17
Corr. for daily variation 50m., and 4h. 9m. (Table XVI.)	+ 8	
Mean time when the moon bears West of the meridian, at the given place		14 46
Equation of time by Page II. of the Nautical Almanac		— 6
Apparent time when the moon bears West of the meridian, at the given place		14 40 P. M.
Or		2 40 A. M.

Example II. At what apparent time will the moon be nearest to the prime vertical, before it has passed the meridian, on October 26, 1866, in latitude 13° N., and longitude 68° W.?

Mean time of the moon's meridian passage at Greenwich, Oct. 26, by Page IV. of the Nautical Almanac	14h. 45m.
Corr. for daily variation 60m., and longitude 68° W. (Table XVI.)	+ 11
Mean time of the moon's meridian passage at the given place	14 56
Longitude 68° W., in time (Table XIX.)	4 32 W.
Mean time at Greenwich when the moon passes the meridian of the given place	19 28

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* The Time found by the Table will not be quite correct, since it is taken out with the moon's declination at the time of its meridian passage, whereas it should be for the time of its being on or near the prime vertical; but the result will be sufficiently near the truth, for the purpose to which it is here applied.

Mean time of the moon's meridian passage at the given place		14h. 56m.
Time from Table corresponding to 18° 00′ N. (the moon's declination at 19h. 28m. Greenwich mean time by Page XI. of the Naut. Alm.) and latitude 13° N.........	2h. 59m.	3 6
Corr. for daily variation 60m. and 2h. 59m. (Table XVI.) ...	+ 7	
Mean time when the moon is nearest the prime vertical, to the Eastward..		11 50
Equation of time by Page II. of the Nautical Almanac		+ 16
Apparent time when the moon is nearest the prime vertical, to the Eastward..		12 6 P.M.

TABLE XLVI.

For finding the Altitude of a Celestial Object most advantageous for ascertaining the Apparent Time.

By this Table the altitude of a celestial object may be found nearly, when the object is in the prime vertical, or at its nearest approach thereto. It is to be entered, as in the last Table, with the declination at the top, and the latitude in the left column.

Example I. Required the altitude of the sun when it is in the prime verticle, May 20, 1866, in latitude 31° 45′ N.
The latitude 32° in the left column, and the declination 20° N. at the top, give the corresponding altitude 40° 12′.

Example II. Required the altitude of the Star Regulus, when it bears due East or West, on February 6, 1866, in latitude 47° N.
The altitude in the Table, corresponding to latitude 47°, and the star's declination 13° N., is nearly 18°.

Example III. Required the altitude of the Planet Jupiter, on July 14, 1866, when it is in the prime vertical, in latitude 48° S.
The altitude corresponding to latitude 48°, and the planet's declination 21° 3′ N., is about 28° 50′.

Example IV. What will be the altitude of the moon when it is nearest to the prime vertical, eastward of the meridian, on October 26, 1866, in latitude 13° N., and longitude 68° West?
The latitude 13° N., and the moon's declination 18° N., give the moon's altitude about 46° 43′.

Note. *See* the above Examples worked in the explanation of the preceding Table, for finding the time when an object is on or near the prime vertical.

TABLE XLVII.

Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich

The moon's right ascension and declination being given in the new Nautical Almanacs to every hour of Greenwich mean time, this Table is intended principally to reduce them to any interval between the hours, by finding the proportional part of the change in one hour: the figures at the head of the columns being taken as minutes of an hour or a degree, and those in either side column as seconds.

To reduce the moon's right ascension or declination to any given mean time at Greenwich, take them out from the Nautical Almanac for the hours on the given day, preceding and following the Greenwich time, and find the hourly variation; then adding together its logarithm, and the logarithm of the minutes and seconds of the time at Greenwich since the preceding hour, their sum will be the log. of the variation or change in that time; which being applied to the right ascension or declination at the preceding hour, by addition or subtraction, according as the quantity is increasing or decreasing, the result will give them reduced to Greenwich mean time.

Example I. Required the moon's right ascension and declination, March 13, 1866, at 14h. 36m. 15s. mean time at Greenwich.

Moon's right ascen., March 13, at 14h., by Page VIII. N. Alm.	21h. 7m.56s.	
Ditto, ditto at 15h., ditto	21 10 13	
Variation in 1 hour or 60 minutes	2 17	...Log. 1.4196
Mean time at Greenwich after 14h.	36m.15s.	...Log. 0.2188
Variation or change in 36m. 15s.	+h. 1m.23s.	...Log. 1.6384
Moon's right ascension, March 13, at 14h.	21 7 56	
Ditto at 14h. 36m. 15s. Greenwich mean time...	21 9 19	
Moon's declination, March 13, at 14h., by Page VIII. N. Alm.	11° 55′ 6″ S.	
Ditto, ditto at 15h., ditto	11 46 44 S.	
Variation in 1 hour or 60 minutes	8 22	......Log. 0.8556
Mean time at Greenwich after 14h.	36m.15s.	...Log. 0.2188
Variation or change in 36m. 15s.	−° 5′ 3″	...Log. 1.0744
Moon's declination, March 13th, at 14h.	11 55 6 S.	
Ditto, at 14h. 36m. 15s. Greenwich mean time	11 50 3 S.	

Example II. Required the moon's right ascension and declination, May 23, 1866, at 2h. 48m. 35s. Greenwich mean time.

Moon's right ascen., May 23, at 2h., by Page X. Naut. Alm. ...	11h. 46m.56s.	
Ditto, ditto, at 3h., ditto	11 48 51	
Variation in 1 hour or 60 minutes	1 55	......Log. 1.4956
Mean time at Greenwich after 2h.	48m.35s.	...Log. 0.0917
Variation or change in 48m. 35s.	+h. 1m.33s.	...Log. 1.5873
Moon's right ascension, May 23, at 2h.	11 46 56	
Ditto, at 2h. 48m. 35s. Greenwich mean time......	11 48 29	
Moon's declination, May 23, at 2h., by Page X. Naut. Alm. ...	0° 4′ 56″ N.	
Ditto, ditto, at 3h., ditto	0 4 40 S.	
Variation in 1 hour or 60 minutes	9 36	......Log. 0.7959
Mean time at Greenwich after 2h.	48m.35s.	...Log. 0.0917
Variation or change in 48m. 35s.	−° 7′ 46″	...Log. 0.8876
Moon's declination, May 23, at 2h.	0 4 56 N.	
Ditto at 2h. 48m. 35s. Greenwich mean time......	0 · 2 50 S.	

TABLE XLVIII.

The Parallax in Altitude for Planets

Opposite the apparent altitude of the planet, in one of the side columns, and under the horizontal parallax, will be found its parallax in altitude, which is always to be added to the altitude of the planet.—*Example.* If the altitude of a planet be 40°, and horizontal parallax 15″, its parallax in altitude will be 12″ by the table.

TABLE XLIX.

To correct the Logarithmic Difference when a Planet is observed.

The corrections in this table are to be taken out with the planet's apparent altitude in the right or left column, and the horizontal parallax (found in the Nautical Almanac) at the top, and is to be subtracted from the logarithmic difference taken from Table XXXIX.

Example. Required the correction of the logarithmic difference corresponding to the apparent altitude of a planet 12°, and horizontal parallax 15″.

Opposite 12°, and under 15″, will be found the corresponding correction 9.

TABLE L.

To correct the Auxiliary Angle when a Planet is observed.

The corrections in this table are taken out with the same arguments as the last; that is, with the planet's apparent altitude in either side column, and the horizontal parallax at the top, and is always additive to the auxiliary angle taken from Table XXX*.

Example. Required the correction of the auxiliary angle corresponding to the apparent altitude of a planet 65°, and horizontal parallax 19″.

Opposite the apparent altitude 65°, and under the horizontal parallax 19″, is the corresponding correction 10″.

TABLE LI.

To reduce the Equation of Time to any Time at Greenwich.

This table is to be entered with the daily change or variation of the equation of time (being the difference of the equations at the preceding and following noons, taken from Page I. or II. of the month in the Nautical Almanac, when they are both additive, or both subtractive, but their sum when one is subtractive, and the other additive,) at the top, and the Greenwich time in the left side column; the corresponding correction is then to be applied to the equation at the preceding noon, by addition or subtraction, according as the equation is increasing or decreasing. But should the correction exceed the equation at the preceding noon, the latter is to be subtracted from the correction, and the remainder will be the reduced equation, to be applied in the same way as directed in the Nautical Almanac for the equation at the following noon.

When the Greenwich time exceeds 12 hours, the correction must be taken out at twice, as in the third and fourth Examples.

Example I. Required the equation of time, March 1, 1866, at 3 hours apparent time at Greenwich.

Equation of time at app. noon, March 1, by Page I. Naut. Alm.	12m.	34. 63s.
Ditto, March 2, by ditto	12	22. 35s.
Daily change or variation (decreasing)	0	12. 28
Equation of time (as above) March 1	12m.	34. 63s.
Correction to difference 12s. and 3 hours	—	1. 53
Reduced equation of time (to be added to apparent time)	12	33. 10

Hence the mean time at 3 hours apparent time at Greenwich, on March 1 1866, is 3h. 12m. 33. 10s.

Example II. Required the equation of time, on December 2, 1866, at 8h. 30m. apparent time at Greenwich.

Equation of time at apparent noon, Dec. 2, by Page I. Naut. Alm.	10m.	24. 47s.
Correction to daily change or variation 23. 64s. and 8h. 30m.	—	8. 30
Reduced equation of time (to be subtracted from apparent time)	10	16. 17

Example III. Required the equation of time on April 7, 1866, at 16h. 35m. mean time at St. Helena, in longitude 5° 45′ W.

Mean time at St. Helena		16h.	35m.
Longitude 5° 45′ in Time (Table XIX.)		+	23 W.
Mean time at Greenwich		16	58
Equation of time at mean noon, April 7, by Page II. of Naut. Alm.		2m.	10. 7s.
Corr. to daily variation 17. 1s. and 12 hours	= 8. 5s.	—	12. 0
Ditto 4h. 58m	= 3. 5		
Reduced equation of time (to be subtracted from mean time)		1	58. 7

Example IV. Required the equation of time on June 14, 1866, at 22h. 30m. Greenwich apparent time.

Equation of time at apparent noon, June 14, by Page I. of Naut. Alm.		0m.	6. 9s. —
Corr. to daily variation 12. 7s. and 12 hours	6. 3s.	0	11. 8
Ditto 10h. 30m.	5. 5		
Reduced equation (to be added to apparent time)		0	4. 9 +

In this example, the equation of time, on June 14, at Greenwich apparent noon, is 0m. 6. 89s. *subtractive,* and on the following noon it is 0m. 5. 84s. *additive;* therefore the equation having first decreased to 0, and then increased their sum (12. 73s.) is the amount of the daily variation or change in 24 hours; and since the correction is greater than the equation on the 14th, at apparent noon, the latter is to be subtracted from the correction, and the remainder will be the reduced equation 0m. 4. 9s., to be *added* to apparent time in order to reduce it to mean time: hence the mean time corresponding to 22h. 30m. apparent time, will be 22h 30m. + 0m. 4. 9s. = 22h. 30m. 4. 9s.

TABLE LII.

Equations of Equal Altitudes.

Observations of the sun, taken when at equal altitudes afford an easy and accurate method of ascertaining the time shewn by a chronometer at apparent or mean noon, and from thence its error; but since the sun changes his declination during the interval between the corresponding altitudes, the middle of the times by the chronometer when they were taken, will not be that shewn by it when the sun passes the meridian; and hence it becomes necessary to apply a correction, called the equation of equal altitudes, to the middle of the times, which may be easily computed as follows, by means of this Table.

RULES.—1. Opposite the interval between the observations, take out the logarithms marked A. and B. at the head of the columns.

2. To log. A. add the log. (XXIV.) of the seconds in the change of the sun's declination between the noons of the preceding and following days, (taken from the Nautical Almanac,) and the log. tangent (XXV.) of the given latitude; the sum of these three logs. will be the log. (XXIV.) of the *first* part of the equation.

3. To log. B. add the log. of the above seconds, and the log. co-tangent of the sun's polar distance to the nearest minute of the given day; their sum will be the log. of the *second* part of the equation.

4. The *first* part of the equation *additive* when the declination is decreasing, and of the same name with the latitude; or increasing, and of a different name from the latitude; but *subtractive*, when the declination is increasing, and of the same name with the latitude; or decreasing, and of a different name from the latitude.

5. The *second* part of the equation is *additive* when the declination is increasing; but *subtractive* when the declination is decreasing.

EXAMPLE I. November 10, 1866, in latitude 57° 9′ N., suppose the interval between two sets of equal altitudes of the sun to be 5h. 17m.: required the equation of equal altitudes.

Sun's decl., Nov. 9, by N. A.	16° 53′ 20″ S.			Sun's decl., Nov. 10, by N. A...	17° 10′ S.
Ditto, Nov. 11	17 27 4 S.				90
Change of declin. in 2 days.	33 44 = 2024″			Sun's polar distance...............	107 10
Interval	5h. 17m.	Log. A.	7.7599	.... Log. B...	7.6465
Change in 2 days ...	2024″	Log. ...	3.3062	....	3.3062
Latitude	57° 9′	Tang...	0.1900	Polar dist. 107° 10′ Co-tang.	9.4898
First part...	+ 18.03s.	Log. ...	1.2561	Second part + 2.77s. Log. ...	0.4425
Second part	+ 2.77				
Eq. of equal parts...	+ 20.80	additive, because both parts are so.			

But if we suppose the above latitude to be *South*, then the first part would be subtractive, because the declination is increasing, and would be of the same name with the latitude; the second part would be additive, because the sun's declination is increasing: consequently, the difference of the two parts = 15.26s. would then be the equation of equal altitudes, and subtractive, because the greater part is so.

EXAMPLE II. March 20, 1866, in latitude 20° 33′ S., suppose the interval between two sets of equal altitudes of the sun to be 8h. 18m.: required the equation of equal altitudes.

Sun's decl., Mar. 19, by N. A.	0° 31′ 23″ S.	Sun's decl., March 20......	0° 8′ S
Ditto, Mar. 21,............	0 16 00 N.		90
Change of declin. in 2 days...	0 47 23 = 2843″	Sun's polar distance	89 52

Interval	8h. 18m.	Log. A.	7. 8138	.... Log. B.	7. 4818
Change in 2 days	2843″	Log. ...	3. 4538	....	3. 4538
Latitude	20° 33′	Tang...	9. 5739	Polar dist. 89° 52′...Co-tang.	7. 3668
First part.........	+ 6.94s.	Log. ...	0. 8415	Second part —0. 02 Log. ...	8. 3024
Second part......	— 0.02				

Eq. of equal alts. + 6. 92 additive, because the greater part is so.

If we suppose the latitude in the above example to be *North*, the first part would be subtractive, because the declination is decreasing, and of a different name from the latitude; the second part would be subtractive, because the declination is decreasing: hence the sum of the parts, 6. 96s., would be the equation of equal altitudes, and subtractive, because both would have been so.

TABLE LIII.

For converting Foreign Measures into English Feet or Fathoms, and the contrary.

This table will be found very useful in converting the depths of water expressed in foreign charts, to equivalent depths in English feet or fathoms. Suppose, for example, the number of feet or pieds marked on a bank in a French chart were 17; to find the corresponding depth in English feet, look in the column, marked "French feet," for the number nearest answering to 17: this will be 16. 90, opposite to which, in the left column, will be found 18, the English feet required. Or, suppose the number of Spanish brazas answering to 20 English fathoms, were required: in the column marked "Spanish brazas," opposite 20 in the column of English fathoms, will be found 21. 58, the number of Spanish brazas equivalent to 20 English fathoms.

The columns in the table were computed by the following rules:

1. *To reduce English feet to French feet, or English fathoms to French toises,* add the log. 9. 972647 to the log. of the given number of English feet or fathoms, and the sum will be the log. of the corresponding French feet or toises.

2. *To reduce English fathoms to French brasses,* add the log. 0. 051516 to the log. of the given number of English fathoms.

3. *To reduce English fathoms or feet to Spanish brazas or feet,* add the log. 0. 033074 to the log. of the English fathoms or feet.

4. *To reduce English feet to Portuguese feet,* add the log. 9. 966926 to the log. of the English feet.

5. *To reduce English fathoms to Portuguese brazas or fathoms,* add the log. 9. 920818 to the log. of the English feet.

6. *To reduce English feet to Amsterdam feet,* add the log. 0. 032292 to the log. of the English feet.

7. *To reduce English feet to Rynland feet,* add the log. 9. 987514 to the log. of the English feet.

8. *To reduce English feet or fathoms to Swedish feet or fathoms,* add the log. 0. 011570 to the log. of the English feet.

9. *To reduce English feet to Venetian feet,* add the log. 9. 943094 to the log. of the English feet.

10. *To reduce English fathoms to Venetian passi,* add the log. 0.022276 to the log. of the English fathoms.

11. *To reduce English feet to Russian feet,* add the log. 9.940878 to the log. of the English feet.

The pages not admitting of more columns, the following Rules may be added.

1. *To reduce English feet or fathoms to Danish feet or fathoms,* add the log. 9.987501 to the log of the English feet or fathoms.

2. *To reduce English fathoms to Russian sagenes or sashes,* add the log. 9.933085 to the log. of the English fathoms.

TABLE LIV.

For finding the exact Greenwich Time corresponding to the true Lunar Distance.

If the moon's motion in the heavens were uniform, the true lunar distance would always give the corresponding Greenwich mean time by the Rule in page 270; but as this is not the case, when great accuracy is desired the interval found by the proportional logarithms should be corrected by a number of seconds taken from this table in the following manner :—

Find the difference between the prop. logs. standing opposite the two distances in the Almanac, which include the given true distance; with this difference at the top of the Table, and the approximate interval in one of the left columns, take out the correction in seconds, which *add* to the appoximate interval when the prop. logs are *decreasing,* or *subtract* from it when *increasing,* and the result will be the true interval.

EXAMPLE I. Required the correct time at Greenwich corresponding to 106° 14′ 34″, the true distance between the sun and moon on May 6, 1866, (*See* Example I., page 274.)

The true distance at noon by p. XIII., of N. A., May 6, is 106° 35′ 50″ its P. Log. 3152
Ditto, at III h. ditto May 6, 105 8 44 its P. Log. 3138

Difference 14

Correction in the Table opposite the approximate interval 43m. 56s., and under 10 is 2s.
Ditto ditto 43 56 and under 4 is 1

Correction of the approximate interval ...... 3s.

The above correction 3s. being *subtracted* from the approximate interval 0h. 43m. 56s., because the prop. logs. are *increasing,* the difference 0h. 43m. 53s. is the true interval: hence the exact Greenwich mean time is 0h. 43m 53s.

EXAMPLE II. Required the exact Greenwich time corresponding to 77°39′26″ the true distance between the moon and the Star α Aquilæ, on June 23, 1866, (*See* Example VII. page 294.)

The true distance at III. hrs. by Page XVI. of Naut. Alm. is 78° 16′ 27″ its P. Log. 3510
Ditto at VI. hrs. ditto 76 56 14 its P. Log. 3515

Difference.. 5

Correction in the Table opposite the approximate interval 37m. 1s. and under 5 is ...... 1s.
Ditto ditto and under 0 is 0

Correction of the approximate interval ...... 1s.

The correction 1s. being *subtracted* from the approximate interval 0h. 37m. 1s., because the prop. logs. are *increasing*, the difference 0h. 37m. 0s. is the true interval; and hence the exact Greenwich mean time is 3h. 37m. 0s.

Hence, in this Example, the omission of this correction would only produce an error of 0′ 15″ in the longitude. Cases however may occur, in which it would be greater.

TABLE LV.

To reduce the Moon's Horizontal Parallax, or Semidiameter, to any Time under the Meridian of Greenwich.

This Table contains the proportional parts to be applied to the moon's horizontal parallax and semidiameter, (given in the Nautical Almanac for noon and midnight,) in order to reduce them to the time of observation: it is to be entered with the Greenwich time after noon or midnight at the top, and the difference in 12 hours in either side column. The proportional parts thus found are to be added to, or subtracted from, the horizontal parallax and semidiameter, at the preceding noon or midnight, according as they are increasing or decreasing.

TABLE LVI.

Latitudes and Longitudes.[*]

This Table contains the latitudes and longitudes, from the meridian of Greenwich, of the principal ports, harbours, capes, shoals, rocks, &c. in the world. It is divided into sections, and arranged according to the country, sea, or coast, to which they belong. The manner of finding any required place, supposing its situation nearly known, is so obvious, that it needs no further explanation.

The variation of the compass, as it stands at the present time, is occasionally inserted for the information of such persons as may not have an opportunity of finding it by observation.

TABLE LVII.

Times of High Water.

This Table contains the times of high water on the full and change of the moon, at the principal ports, and along the coasts, particularly of Great Britain and Ireland, with the vertical rise of the tide in feet at spring tides; the names of the places being alphabetically arranged.

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[*] The Author, impressed with the importance of this Table, has used every exertion to render it as complete and correct as possible, by consulting the works of the best Navigators and Astronomers, at the same time comparing them with the most accurate charts and surveys, and by procuring the assistance of his nautical friends, from whom it has received considerable improvements: he therefore flatters himself the present Table may be esteemed not only one of the most extensive, but likewise the most correct, of any hitherto published. Conscious, however, that errors must exist in a Table which depends on observation (although he trusts they are few and inconsiderable), he takes this opportunity of earnestly requesting the intelligent mariner to communicate to him any he may discover; for it is only by the accumulated knowledge of such men, that we can hope to approach perfection on hydrographical subjects.

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NAVIGATION.

INTRODUCTION.

NAVIGATION is that Art which instructs the mariner in what manner to conduct a ship through the wide and trackless ocean, from one part to another, with the greatest safety, and in the shortest time possible.

It is difficult to trace the origin of this most important Art, to which a diversity of events might have given rise; but, in all probability, it owes its birth to necessity, the parent of almost every human invention. The Sea Coasts, in many places, are full of islands at no great distance from the Continent: curiosity would naturally inspire men with an inclination to visit these islands, and consequently prompt them to devise means by which they might convey themselves from one place to another on the surface of the water; and as this passage did not appear either very long or very dangerous, they determined to attempt it: success in one of these efforts might encourage a second; and we are informed by Pliny, that anciently they sailed only among the islands, and passed over on rafts or logs of wood.

As Science and Commerce advanced, the machines first used would of course give way to others of more improved structure and greater convenience; and hence the invention of boats and vessels of various denominations, better adapted to the nature and extent of the voyages undertaken In process of time, men being convinced by experience that vessels designed for navigating the seas, ought to be of a different construction from those intended for rivers, they would make it their study to give such a form and solidity to ships designed for the sea, as would enable them to resist the impetuosity of its waves.

The action of the wind, of which the effects are so sensible and so frequent, might soon suggest the use of sails; but the manner of adjusting and managing them was more difficult, and would not be so soon discovered: this, in fact, appears to have been the last part of the general construction of vessels that was found out; and this opinion seems confirmed by the practice of savages in the South Seas and other parts, who generally use only oars or paddles, but seldom have sails: such must have been the case in the first ages.

The confusion and uncertainty in which the first navigators must have found themselves, when either prompted by their enterprising spirit to visit remote parts, or driven by the violence of storms out of the sight of land would naturally induce them to study some method of finding where they were in such circumstances: they might soon be sensible that the inspection of the heavenly bodies was the only means that could afford them just conclusions in this respect; in this manner, probably, Astronomy came to be applied to Navigation

However, leaving these speculations respecting the rise and progress of Navigation, history informs us that the Phœnicians were the first who attained any great proficiency in the Art, especially those of Tyre, their capital, who sent out various colonies, the principal of which settled on the Coast of Africa, and built Carthage, a city that in time rivalled Tyre itself. After the destruction of Tyre by Alexander the Great, the Art was transferred by the conqueror to Alexandria, a new city in Egypt, intended by him for the capital of the world; thence diffusing itself, in process of time, throughout the whole of the Mediterranean, and parts adjacent.

But Navigation at that time consisted of little more than the management of small barks, which crept along the shore, seldom losing sight of the land: it was not till the discovery of the compass that mariners ventured to explore the vast ocean, and sought, as it were, for other worlds, at an immense distance: since that period, the Art has been continually receiving fresh improvements from the efforts of learned and ingenious men, both in respect to the construction of vessels, and the methods of working and conducting them; so that, at the present time, a voyage to the remotest part of the globe may be performed in the short space of a few months.

Navigation may be divided into two branches: viz. *Seamanship*, comprehending the method of managing a vessel by disposing her sails, rudder, &c. so that she may move in any assigned course or direction the wind or weather will permit; and *Navigation Proper* (the part we intend principally to treat of in the present Work), which comprehends those methods by which a mariner determines at any time the situation of his vessel, the course she is to be steered, and the distance she has to run, to gain her intended port: hence the requisites for a mariner, in order to understand this branch of the Nautical Art, are, a competent knowledge of the figure and magnitude of the earth, with the various imaginary circles drawn upon it, so as to be able to ascertain the distance and situation of places with respect to each other; the method of finding the ship's latitude and longitude, either by her course and distance run, or by astronomical observations; the use of various instruments, as the log, compass, half-minute glass, quadrant, sextant, &c.; the different allowances necessary to be made in estimating a ship's way, as for leeway, variation, and currents; the method of finding the time of high water at any place; the use of charts, both Plane and Mercator's, with the method of constructing them; all of which particulars, depending upon mathematical and astronomical principles, with whatever relates to the practical navigator, we shall endeavour, in the following sheets, to explain and illustrate in such a manner as to render every part as clear, concise, and methodical as an Art, embracing such a variety of subjects, will possibly admit.

DECIMAL ARITHMETIC

WHEN any quantity is considered as constituting a whole, it is called an *integer;* and when an integer is supposed to be divided into a certain number of equal parts, any number of these parts, considered in their relation to the whole, is called a *fraction*, which is expressed by two numbers placed one above another with a line between them; the lower of these, called the *denominator*, denotes the number of parts into which the integer or whole is divided, and the upper, called the *numerator*, expresses how many of these parts are contained in the fraction: for instance, suppose a foot divided into 6 equal parts, and 4 of those parts were to be considered as a fraction of the whole; it would be written in numbers thus $\frac{4}{6}$, where the figure under the line shews that the foot is divided into 6 parts, and the 4 above the line denotes the number of those parts contained in the fraction.

Fractions, whose denominators are 10, 100, 1000, &c. that is, a unit with ciphers annexed to it, are called *Decimal Fractions;* but with any other denominators they are called *Vulgar Fractions.*

As the denominators of decimal fractions are always one of the numbers 10, 100, 1000, &c., it is most convenient to write down the numerators only, placing before them a mark called a *decimal point*, to distinguish them from whole numbers; for the value of each place of figures will be known in decimals, as well as in whole numbers, by their distance from the decimal point; which will appear by the following Table, where the figures to the left-hand of the decimal point are considered as whole numbers, and those to the right, decimals.

WHOLE NUMBERS.								DECIMALS.					
5	6	4	5	6	8	7	.	2	4	6	8	9	3
Millions.	Hund. of Thousands.	Tens of Thousands.	Thousands.	Hundreds.	Tens.	Units.		Tenths.	Hundredths.	Thousandths.	Ten Thousandths.	Hund. Thousandths.	Millionths.

Thus .2 or $\frac{2}{10}$ is read two-tenths, and 87.24, eighty-seven and twenty-four hundredths; the latter of these is called a *mixed number*, because it consists of a fraction and an integral or whole number.

In setting down a decimal fraction without its denominator, the numerator must consist of as many places as there are ciphers in the denominator;

and if it have not so many figures, the defect must be supplied by setting ciphers before them; thus, $\frac{3}{10}$ is .3, and $\frac{16}{100}$ is .16, and $\frac{14}{1000}$ is .014, and $\frac{5}{1000}$ is .005, &c.

Hence it appears, that as ciphers on the right-hand of whole numbers *increase* their value decimally, or in a tenfold proportion, as 5, 50, 500, &c., so when set on the left of decimal fractions, they *decrease* the value decimally, or in a tenfold proportion, as .5, .05, .005, &c. But ciphers set on the other sides of these numbers make no alteration in their value, either of increase or decrease: so 5, or 05, or 005, &c. are all of the same value, as are .5, or .50, or .500, &c.; for in the latter case it is evident that the numerator increases in the same proportion as the denominator.

Having thus briefly explained the nature of fractions, we shall now proceed to lay down the Rules necessary to be understood in the practice of Navigation, giving a few examples to each by way of illustration.

ADDITION AND SUBTRACTION.

Rule. These are performed exactly the same as in whole numbers, observing always to place the decimal points in a line, so that figures of the same denomination may range under each other.

EXAMPLES IN ADDITION.

.5	53.2	65.	720.1464
.75	79.46	246.3	39.
.253	2.304	19.24	7.246
.582	127.4	121.46	259.1703
2.085	262.364	452.00	1025.5627

EXAMPLES IN SUBTRACTION.

.75	246.25	174.	176.014
.5	19.5	2.561	29.008
.25	226.75	171.439	147.006

MULTIPLICATION.

Rule. Multiply the given numbers together as if they were whol numbers, and point off as many decimals in the product, counting from th right-hand, as there are decimals in the multiplicand and multiplier together When it happens that there are not so many figures in the product as there must be decimals, supply the defect by prefixing ciphers on the left hand.

EXAMPLES.

.25 Multiplicand.	3.275	.2376
.42 Multiplier.	29.5	.0062
50	16375	4752
100	29475	14256
.1050 Product.	6550	00147312
	96.6125	

DIVISION.

Rule. Divide as in whole numbers, observing that the divisor and quotient are to contain together as many decimal figures as there are in the dividend; if therefore the dividend have just as many places of decimals as the divisor, the quotient will be a whole number without any decimal figures. If there be more places of decimals in the dividend than in the divisor, point off as many figures in the quotient as there are decimals. in the dividend more than in the divisor, a want of places in the quotient being supplied with ciphers on the left-hand; and if there be more places of decimals in the divisor than in the dividend, add ciphers to the dividend to make as many places of decimals as in the divisor; then the quotient will be a whole number, without decimals.

When, after the division, there is a remainder, ciphers may be added to the dividend, and the operation continued as before, until either there be no remainder, or a sufficient degree of exactness be obtained in the quotient.

EXAMPLES.

Divisor.	Dividend.	Quotient.
6.5)	7234.5	(1113.
	65	
	73	
	65	
	84	
	65	
	195	
	195	

Divisor.	Dividend.	Quotient.
12.5)	.45695	(.0365
	375	
	819	
	750	
	695	
	625	
	70	

Divisor. Dividend. Quotient.
.423) 476.520 (1126
423
535
423
1122
846
2760
2538
222

Divisor. Dividend. Quotient.
96) 2.30000 (.02395
1 92
380
288
920
864
560
480
80, &c.

REDUCTION.

To reduce a Vulgar Fraction to a Decimal of the same Value.

Rule. Add ciphers at pleasure to the numerator, and divide by the denominator; the quotient will be the decimal fraction required.

EXAMPLES.

Reduce $\frac{3}{6}$ of a mile to a decimal fraction.

6) 3.0
.5 or $\frac{5}{10}$

which is a decimal of the same value with the proposed vulgar fraction $\frac{3}{6}$.

Reduce $\frac{23}{60}$ of a degree to a decimal fraction.

60) 23.000 (.383 or $\frac{383}{1000}$ nearly.
180
500
480
200
180
20, &c.

Every quantity may be considered as a fraction of a larger of the same kind: as a league the $\frac{1}{20}$ of a degree; an inch, the $\frac{1}{12}$ of a foot, &c.; and therefore may be reduced to a decimal fraction, as in the following

EXAMPLES.

What decimal part of a foot is 9 inches?

12) 9.00
.75 or $\frac{75}{100}$,

which is equal to $\frac{9}{12}$ of a foot.

What is the decimal value of 15 miles, considered as a fraction of a degree?

60) 15.00 (.25 or $\frac{25}{100}$.
120
300
300

When the given quantity consists of several denominations, reduce them to the lowest, as in common Arithmetic; likewise reduce the integer to the same denomination; then proceed as before.

EXAMPLES.

Reduce 1 foot 6 inches to the decimal of a yard.

Ft.	In.	Ft.
1	6	3 = 1 Yard.
12		12
18 Numerator.		36 Denominator.

36) 18.0 (.5 Answer.
180

Reduce 21 minutes 54 seconds to the decimal of a degree.

	Min.	Sec.	Sec.
	21	54 =	1314 Numerator.
1 deg. or	60	0 =	3600 Denominat.

3600) 1314.000 (.365 Answer.
10800
23400
21600
18000
18000

To find the Value of a Decimal Fraction in Money, Weight, Measure, &c.

Rule. Multiply the decimal by the number of parts of the next inferior denomination contained in the integer; pointing off in the product as many places for decimals, to the right-hand, as the given decimal consists of, and those to the left-hand will be an integer number: then multiply the remaining decimals by the number of parts contained in the next inferior denomination, and point off the decimals as before. Proceed thus till it be brought to the lowest denomination.

EXAMPLES.

What is the value of .875 of a pound sterling?

	.875
	20
Shillings	17.500
	12
Pence	6.000

Answer, 17s. 6d.

What is the value of .42 of a degree?*

	.42
	60
Minutes	25.20
	60
Seconds	12.00

Answer, 25 minutes 12 seconds.

---

* When tenths of a degree or minute are to be reduced into minutes or seconds, it may be expeditiously done by multiplying the tenths by 6, and the product will give the minutes or seconds required: for example, .5 of a degree multiplied by 6 gives 30 minutes, and .9 of a minute, 54 seconds. On the contrary, to reduce minutes and seconds to tenths of a degree or minute, divide them by 6.

What is the value of . 16669 of a yard?

. 16669
3
Feet . 50007
12
Inches 6. 00084

Answer, 6 inches nearly.

What is the value of . 259 of a league?

. 259
3
Miles 777
8
Furlongs 6. 216
220
Yards 47. 520

Answer, 6 furlongs 47. 52 yards.

RULE OF THREE.

When three numbers are given to find a fourth proportional, the method by which it is performed is called the Rule of Three, and is the same in decimals as in common Arithmetic: *viz.* by multiplying the second and third terms together, and dividing the product by the first, when the quotient will give the fourth term, or proportional number required, of the same kind with the second. If the given numbers consist of several denominations, they are to be reduced to decimals by the preceding Rules.

EXAMPLES.

If a ship sail 49. 5 miles in 8 hours, how many miles will she run in 24 hours, supposing her to go at the same rate?

Hours. Miles. Hours.
8 : 49. 5 :: 24
24
1980
990
8) 1188. 0
Miles 148. 5 Answer.

Suppose a watch or time-piece gain 14 seconds in 5 days 6 hours, how much will it gain in 17 days 15 hours?

6 hours = . 25 of a day.
15 hours = . 625 of a day.

Days. Seconds. Days.
5. 25 : 14 :: 17. 625
17. 625
70500
17625
Sec.
5. 25) 246. 750 (47 Answer.
2100
3675
3675

LOGARITHMICAL ARITHMETIC.

LOGARITHMS* are a series of artificial numbers, originally invented by John Napier, Baron of Merchiston in Scotland, and afterwards improved by Mr. Briggs, in order to expedite long calculations in arithmetic; for by using these numbers, the tedious operations of Multiplication and Division are avoided, and performed by Addition and Subtraction. This method of calculation is called *Logarithmical Arithmetic*

MULTIPLICATION.

Rule. Add together the logarithms of the two numbers to be multiplied (found in Table XXIV.) and their sum will be a logarithm, the natural number corresponding to which will be the product required: if either the multiplicand or multiplier, or both of them, should consist wholly of decimals, and the index of the sum exceed 10, reject the 10, and the remainder will be the index of the logarithm answering to the product.

EXAMPLES.

Multiply	25	Log. 1.39794	Multiply	23.2	Log. 1.365488
by	3	Log. 0.47712	by	.6	Log. 9.778151
Product	75	Log. 1.87506	Product	13.92	Log. 1.143639
Multiply	3.71	Log. 0.56937	Multiply	.246	Log. 9.390935
by	2.5	Log. 0.39794	by	.07	Log. 8.845098
Product	9.275	Log. 0.96731	Product	.01722	Log. 8.236033

DIVISION.

Rule. From the logarithm of the dividend subtract the logarithm of the divisor, and the remainder will be a logarithm, whose corresponding number will be the quotient required. When the index of the divisor exceeds that of the dividend, borrow 10, and the remainder will be the index of the quotient.

---

* For the history, nature, and construction of Logarithms, see the Introduction to Dr. Hutton's Set of Mathematical Tables; and for the manner in which they are arranged, and are to be taken out in this Work, see the Explanation to Table XXIV.

EXAMPLES.

Divide	75	Log. 1.87506	Divide	139.2	Log. 2.143639
by	3	Log. 0.47712	by	6	Log. 0.778151
Quotient	25	Log. 1.39794	Quotient	23.2	Log. 1.365488
Divide	9.275	Log. 0.96731	Divide	.01722	Log. 8.236033
by	2.5	Log. 0.39794	by	.07	Log. 8.845098
Quotient	3.71	Log. 0.56937	Quotient	.246	Log. 9.390935

INVOLUTION.

Involution is the raising of powers from a given root. When a number is multiplied by itself, the product is called its 2d power, or *square*; when this product is multiplied by the given number, the last product is called its 3d power, or *cube*; and when the multiplication is again repeated, the 4th power, and so on. The 1st power, or number thus raised, is called the *root*, and the number of the power to which the given number is raised, the *index* of that power: hence, to raise or involve a number to a given power, multiply its logarithm by the index of the power to which it is to be raised, and the product will be the logarithm of the power sought.

When the given number is a decimal fraction, prefix as many ciphers, less one, as the index of the product wants of being 10 multiplied by the index of the power.

EXAMPLES.

Required the square, or 2d power, of 15.

Root 15	Log. 1.17609
Index....................	2
Power 225	Log. 2.35218

Required the cube, or 3d power, of 2.5.

Root 2.5	Log. 0.39794
Index.....................	3
Power 15.625	Log. 1.19382

Required the square of .174.

Root .174	Log. 9.240549
Index.................	2
Power .030276	Log. 18.481098

Required the 5th power of .2.

Root .2	Log. 9.301030
Index.................	5
Power .00032	Log. 46.505150

EVOLUTION.

Evolution is the extracting of the root of a given power, or finding a number which, when raised to the given power, will produce the given number: it is consequently the reverse of involution, and is performed by dividing the logarithm of the number by the index of the power, and the quotient will be the logarithm of the root required.

When the given number is a decimal fraction, prefix to the index of its logarithm a figure lessened by one than the index of the power, and divide the whole by the index of the power.

EXAMPLES.

Required the square root of 225.

Power 225	Log. 2)	2. 35218
Root 15	Log.	1. 17609

Required the cube root of 15. 625.

Power 15. 625	Log. 3)	1. 19382
Root 2. 5	Log.	0. 39794

Required the square, or 2d root, of . 030276

Power . 030276	Log. 2)	18. 481098
Root . 174	Log.	9. 240549

Required the 5th root of . 00032.

Power . 00032	Log. 5)	46. 505150
Root . 2	Log.	9. 301030

RULE OF THREE.

Rule. Add the logarithms of the second and third terms together, and from their sum subtract the logarithm of the first term, and the remainder will be the logarithm of the fourth term.

Or, add together the arithmetical complement* of the logarithm of the first term, and the logarithms of the second and third terms; the sum, rejecting 10 from the index, will be the logarithm of the fourth term, or proportional number.

EXAMPLES.

If a ship sail 49. 5 miles in 8 hours, how many miles will she run in 24 hours, supposing her to go at the same rate?

As 8 hours	Log.	0. 90309
Is to 49. 5 miles	Log.	1. 69461
So is 24 hours	Log.	1. 38021
	Sum	3. 07482
		0. 90309
To 148. 5 miles	Log.	2. 17173

Or thus,

As 8 hours Arith. Co.	Log.	9. 09691
Is to 49. 5 miles	Log.	1. 69461
So is 24 hours	Log.	1. 38021
To 148. 5 miles	Log.	2. 17173

Suppose a watch or time-keeper gain 14 seconds in 5 days 6 hours, how much will it gain in 17 days 15 hours?

As 5. 25 days	Log.	0. 720159
Is to 14 seconds	Log.	1. 146128
So is 17. 625 days	Log.	1. 246129
	Sum	2. 392257
		0. 720159
To 47 seconds	Log.	1. 672098

Or thus,

As 5. 25 days Arith. Co.	Log.	9. 279841
Is to 14 seconds	Log.	1. 146128
So is 17. 625 days	Log.	1. 246129
To 47 seconds	Log.	1. 672098

Note.—*See these Examples worked in Decimal Arithmetic.*

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[*] For the method of finding the arithmetical complement of a logarithm, see Explanation to Table XXIV.

PRACTICAL GEOMETRY

DEFINITIONS.

I.

GEOMETRY* is the Science or doctrine of extension, or things extended; that is, of lines, surfaces, and solids; or it is that Science which treats of the descriptions, properties, and relations of magnitude in general.

II.

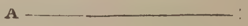
A Point is that which hath no parts, being considered in Mathematics as indivisible, and may be expressed by a dot.

III.

A Line is that which is produced by the motion of a point, and has length without sensible breadth or thickness.

IV.

A strait Line, or right Line, is that which lies evenly between its extremes, without changing its direction, and is the nearest distance between the two points that terminate it, as A B.



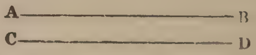
V

A curved Line is that which is not the nearest distance between its extremes or ends, as C D

A line is generally expressed by two letters at its extremes

VI.

Parallel Lines are such as are in the same direction, being in every part at the same distance from each other, and which, if infinitely extended, would never meet; as the lines A B, C D.



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* Geometry originally meant nothing more than the Art of measuring the earth, and is said to have been invented by the Egyptians, who had recourse to it in order to ascertain the artificial boundaries of their land, which were entirely obliterated by the annual inundation of the Nile; but the Science, in its present extended sense, constitutes the principal foundation of all the Mathematics.

VII.

A Superficies, or Surface, is that which is conceived to have length and breadth only, without any consideration of thickness, and its boundaries are lines.

VIII.

A Plane Superficies is that which lies evenly between its extremes so that a right line may wholly coincide with it in all parts and directions.

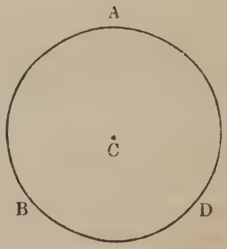
IX.

A Solid is that which hath length, breadth, and thickness, and its bounds or extremes are Superficies.

X.

A Circle is a plane figure bounded by a curved line, called the circumference, as A B D, which is in every part equally distant from a point within it, called the centre, as C; it is formed by the revolution of a line about one of its extremities, which remains fixed.

The circumference of itself is often called the circle, although properly the circle is the space contained within the circumference.

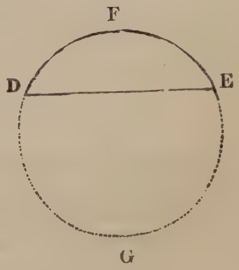


The circumference of every circle is usually supposed to be divided into 360 equal parts, called degrees; each degree into 60 equal parts, called minutes; each minute into 60 equal parts, called seconds; and so on.

Degrees, minutes, and seconds, are thus expressed, 40° 32′ 15″; that is 40 degrees, 32 minutes, and 15 seconds.

XI.

An Arch or Arc of a Circle is any part of the circumference, as D F E.

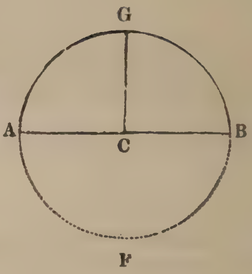


XII.

A Chord is a right line joining the ends of an Arch, as D E; it divides the Circle into two unequal parts, called segments; as D F E and D G E.

XIII.

A DIAMETER is a right line drawn through the centre of a circle, and terminated at both ends by the circumference, as A C B; it divides the circle into two equal parts, called SEMICIRCLES; as A G B and A F B.

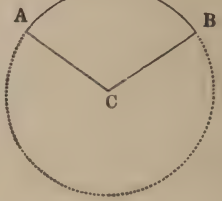


XIV.

A QUADRANT is half a semicircle, or the fourth part of the whole circle, as A C G or G C B.

XV.

A RADIUS, or SEMIDIAMETER, is a right line drawn from the centre to any part of the circumference, and is the extent taken in the compasses to describe a circle, as C A, C G, or C B.

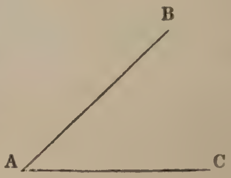


XVI.

A SECTOR is any part of a circle comprehended between two radii and their included arch, as A C B.

XVII.

An ANGLE is the inclination or opening of two lines meeting in one point: the point where they meet is called the ANGULAR POINT, as A; and the lines that include it, the SIDES or LEGS, as A B, or A C.

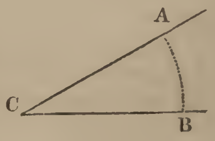


XVIII.

An Angle is sometimes expressed by three letters, the middle one always denoting the angular point, and the other two the legs that include it; but generally by the letter at the angular point only; as the angle B A C, or the angle A.

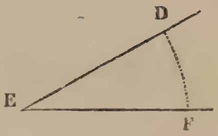
XIX.

An angle is measured by an arch of a circle contained between its legs, making the angular point the centre of the circle; thus the arch A B is the measure of the angle A C B.



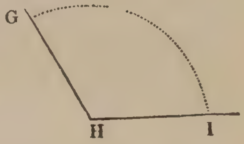
XX.

Angles are said to be equal to each other when the arches that measure them are equal, as the angles A C B and D E F.



XXI.

One angle is esteemed greater or less than another, according as the arch between its legs is greater or less; thus the angle G H I is greater than the angles A C B or D E F.



From the preceding Definitions it will appear evident that the measure of an angle does not depend on the length of its legs, but on their inclination only; for, as we have just seen, the angle G H I is greater than the angles A C B or D E F, although the legs of the latter are longer than those of the former.

XXII.

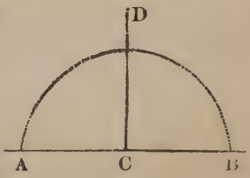
As all circles are supposed to be divided into 360 equal parts, called degrees, &c. a certain number of these divisions will be contained between the two legs of the angle; wherefore an angle is said to measure so many degrees, minutes, &c. as are contained in the arch between the legs.

XXIII.

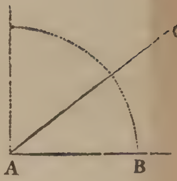
The arch which measures an angle may be described with any radius; for, since the whole circumference of every circle is supposed to be divided into the same number of parts, it hence follows that the divisions will be greater or less in the same proportion as the whole circumference.

XXIV.

When one right line falls upon another, so as to make the angles on each side of it equal, it is called a PERPENDICULAR, and the angles formed by these lines, as the angles A C D, D C B, are called RIGHT ANGLES; now as the semicircle A D B contains 180 degrees (the half of 360), all right angles will contain an arch of 90 degrees, equal to the fourth part of the whole circle.

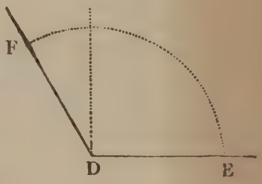


XXV.



An ACUTE ANGLE is that which contains less than a right angle, or 90 degrees, as the angle C A B

XXVI.

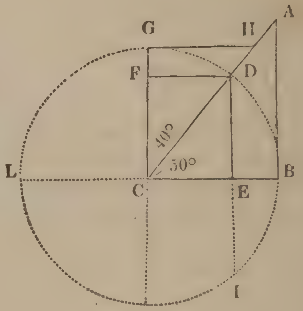


AN OBTUSE ANGLE is that which contains more than a right angle, or 90 degrees, as the angle F D E.

XXVII.

Acute and obtuse angles are called OBLIQUE ANGLES.

XXVIII.



The SINE or RIGHT SINE of an arch is a right line drawn from one extreme of the arch, perpendicular to a diameter drawn to the other extremity, and is equal to half the chord of double the arch; thus D E is the sine of the arch D B, and is equal to half the chord D I of double the arch D B I.

XXIX.

The VERSED SINE of an arch is that part of a diameter contained between the sine and the arch; thus E B is the versed sine of the arch D B.

XXX.

The TANGENT of an arch is a right line drawn perpendicular to the end of a diameter passing through one extremity of the arch, and continued till it meet a right line drawn from the centre through the other end of the arch; thus A B is the tangent of the arch D B.

XXXI.

The SECANT of an arch is a right line drawn from the centre through one end of the arch, till it meet the tangent drawn from the other end; thus C A is the secant of the arch D B.

XXXII

The COMPLEMENT of an arch is what it wants of a right angle, or 90 degrees; thus G D is the complement of D B, or D B of D G.

XXXIII.

The SUPPLEMENT of an arch is what it wants of two right angles, or 180 degrees; thus L D is the supplement of D B, or D B of L D.

XXXIV.

The CO. SINE, CO. TANGENT, CO. SECANT, and CO. VERSED SINE of an arch, is the sine, tangent, secant, and versed sine of the complement of that arch; Co. being a contraction of the word complement: thus D F is the co. sine, G H the co. tangent, C H the co. secant, and G F the co. versed sine, of the arch D B; being the sine, tangent, &c. of the arch D G, the complement of the arch D B.

The sine, tangent, and secant of an arch, as of D B, is likewise the sine, tangent, and secant of the supplement of that arch, as of L D.

XXXV.

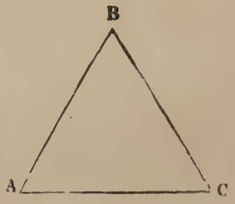
An angle being measured by an arch of a circle, (see Def. XIX.) the sine, tangent, &c. of an arch is the sine, tangent, &c. of the angle which is measured by the arch, or of the degrees and minutes, &c. that the arch contains; hence, supposing the arch D B, which measures the angle D C B, to contain 50 degrees, the lines D E, A B, A C, and E B, will be respectively the sine, tangent, secant, and versed sine of the angle A C B, or of 50 degrees; and consequently the co. sine, co. tangent, co. secant, and co. versed sine, of the angle G C D, or of 40 degrees, the complement of 50 degrees.

XXXVI.

A PLANE TRIANGLE is a figure bounded by three right lines, and contains three angles, of which there are several kinds, both with respect to their sides and angles

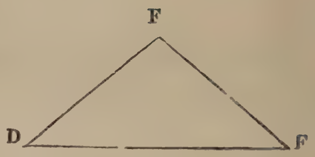
XXXVII.

An EQUILATERAL TRIANGLE is that which has its three sides equal to one another, as A B C.



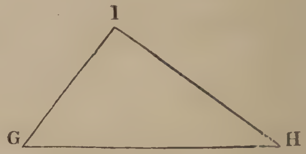
XXXVIII.

An Isosceles Triangle is that which has only two sides equal, as DEF.



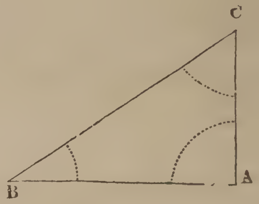
XXXIX.

A Scalene Triangle is that whose sides are all unequal, as GHI.



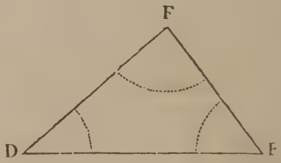
XL.

A Right Angled Triangle is that which has one of its angles right, or containing 90 degrees, as the angle A; the side opposite the right angle is called the Hypothenuse, as BC; and the other two sides are called Legs, that which stands upright, the Perpendicular, as AC, and the other, the Base, as BA.



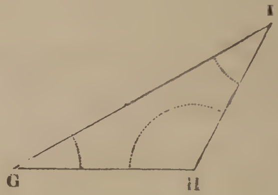
XLI.

An Acute Angled Triangle is that which has all its Angles acute, as DEF.



XLII.

An Obtuse angled Triangle is that which has one of its angles obtuse, as the angle H in the triangle GHI.



XLIII.

All triangles that are not right angled, whether they are acute or obtuse, are, in general terms, called Oblique Angled Triangles, without any other distinction.

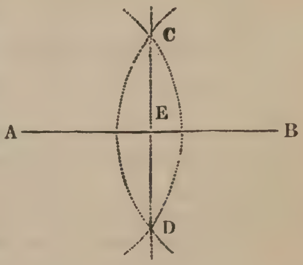
PROBLEMS.

PROBLEM I.

To divide a given right Line A B *into two equal Parts.*

Take any extent in the compasses greater than half the line A B, and with one foot in B describe an arch; with the same radius, and one foot in A, describe an arch cutting the former in C and D; through C and D draw a right line, and this line will divide the given line A B into two equal parts at the point E.

In this manner any arch of a circle may be divided into two equal parts.

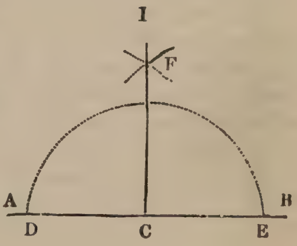


PROBLEM II.

From a given Point C, *in a given right Line* A B, *to raise a Perpendicular.*

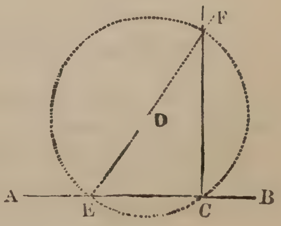
CASE 1st. When the given point C is near the middle of the line A B.

With one foot of the compasses in C, at any distance, draw an arch cutting the line A B in D and E; from the points D and E, with any distance greater than C E or C D, describe two arches cutting each other in F; through the points F and C draw the line I C, and it will be perpendicular to the given line A B.

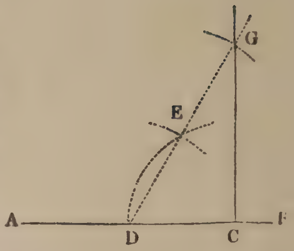


CASE 2d. When the given point C is at, or near the end of the line A B.

Take any point out of the line, as D, and with the distance D C describe a circle, cutting the line A B in E and C; through the centre D and the point E draw the right line E F, cutting the circle in F; then a line drawn through F and C will be the perpendicular required



Or thus: Describe the arch D E at any distance from C, and with one foot of the compasses in D, with the same extent, describe an arch cutting the arch D E in E; from this point, keeping the same extent in the compasses, draw the arch G; through D and E draw the right line D G, cutting the arch in G; then draw a right line through G and C, and it will be the perpendicular required.

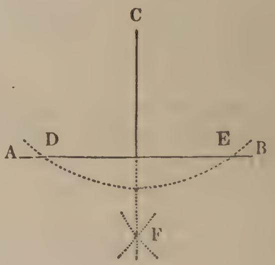


PROBLEM III.

From a given Point C *to let fall a Perpendicular on a given right Line* A B.

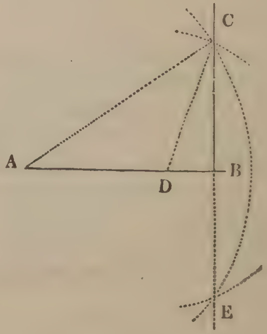
CASE 1st. When the point C is nearly opposite the middle of the line A B.

With one foot of the compasses in C, describe an arch cutting the line A B in D and E; from these points, at any distance, describe two arches cutting each other in F; through the points C and F draw a right line, and it will be perpendicular to the given line A B.



CASE 2d. When the given point C is nearly opposite to the end of the line A B.

Place one foot of the compasses in any part of the given line, as at A, and with the distance A C describe the arch C E; then, from any other part of the given line nearly under the point C, as at D, with the distance D C describe a small arch cutting the arch C E in E; then a line drawn through the points C and E will be perpendicular to the line A B.

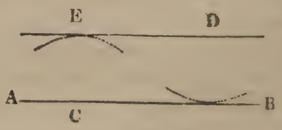


PROBLEM IV.

To draw a right Line parallel to a given right Line A B.

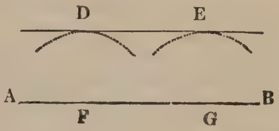
CASE 1st. When the parallel line is to pass through a given point D.

Take the nearest distance between the given point D and the right line A B; with that distance set one foot of the compasses on any



part of the line A B, as at C, and describe the arch E; from the point D draw a line so as just to touch the arch E without cutting it, and that line will be parallel to the given line A B through the given point D.

Case 2d. When the parallel line is to be at a given distance from the right line A B.

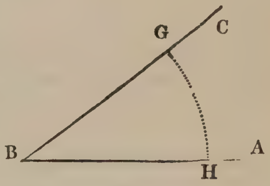


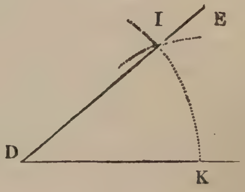
With the given distance in the compasses, describe two arches, D and E, from any two points, as F and G in the given right line; then a line D E drawn just touching the two arches without cutting them, will be parallel to the given line A B.

PROBLEM V.

At a given Point D *in the right Line* D F, *to make an Angle* E D F *equal to a given Angle* C B A.

With one foot of the compasses in B, at any distance, describe the arch G H; through D draw the line D F, and keeping the same extent in the compasses, place one foot in D, and describe the arch in I K; then take the distance G H, apply it to the arch I K from K to I, and through the points D and I draw the line D E; the angle E D F will then be equal to the angle C B A, as was required.



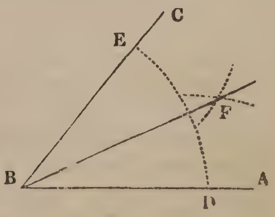


PROBLEM VI.

To divide a given Angle A B C *into two equal Parts.*

From the angular point B, with any extent in the compasses, describe the arch D E; from D and E, with the same or any other extent, describe two arches cutting each other in F; through the points B and F draw a right line, and it will divide the angle into two equal parts.

In the same manner any given arch of a circle is bisected, when the centre of the circle is given.

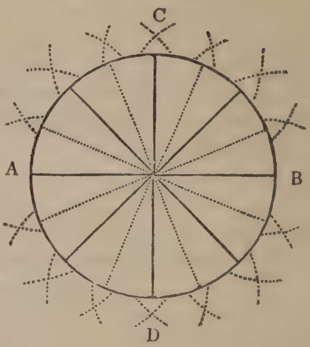


PROBLEM VII.

To divide a Circle A B C D *into two, four, eight, sixteen, thirty-two, &c equal Parts.*

Draw a diameter A B, and it will divide the circle into two equal parts; from the points A and B describe the arches at C and D; a line drawn through these will divide the circle into four equal parts; then bisect the arches A C, C B, &c. by the last problem, and the circle will be divided into eight equal parts, and so on by continual bisections.

This problem is useful in constructing the Mariner's Compass.

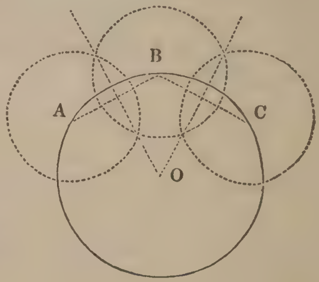


PROBLEM VIII.

To draw the Circumference of a Circle through any three given Points A, B, C, *not situated in a right Line.*

Draw lines joining A B and B C, and bisect them by lines meeting in O, as directed in Problem I.; then from O, at the distance of any one of the points, as O A, describe a circle, and it will pass through the other points B and C, as required.

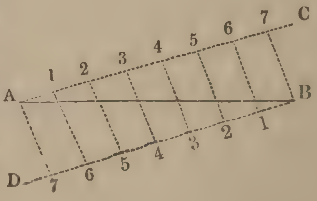
In this manner the centre of a circle may be found; for, taking any three points in the circumference, and proceeding as before directed, the lines meeting at O will give the centre required.



PROBLEM IX.

To divide a given Line A B *into any proposed Number of equal Parts.*

Let it be required to divide the line A B into seven equal parts; from one end A, of the given line A B, draw a right line A C, making any angle with A B, and from the other end B draw a line B D parallel to A C; on each of the lines A C, B D, beginning at A and B, set off as many equal parts as A B is to be divided into, *viz.* seven; then lines drawn from A to 7, 1 to 6, 2 to 5, 3 to 4, &c. will divide the given line into seven equal parts.



PROBLEM X.

To construct Scales of equal Parts.

The simplest scale of equal parts is made by drawing a strait line, an dividing it with a pair of compasses into as many primary divisions as convenient, which, if the line be of a definite length, may be done by Prob. IX., and subdividing one of these decimally, or into ten equal parts; then each of the former may represent 10 units, as leagues, miles, &c., and in that case the latter will represent one of these units: or if the larger divisions be supposed to be 100, then the subdivisions will be tens, and so on. Suppose, for example, it were required to set off from the Scale 25 or 250: set one foot of a pair of compasses on 2 among the primary divisions, and the other on the 5th subdivision; then this extent will represent 25 or 250 miles, leagues, or any other measure of length, as may be required.

There are frequently several of these scales drawn parallel to each other, of different lengths, on a flat rule, (as Fig. 1, Plate I.); they are divided into as many equal parts as the length of the rule will admit; the numbers placed on the left hand shewing how many parts in an inch each scale is divided into. These scales are sometimes subdivided duodecimally, to adapt them to feet and inches when used in Mensuration; or sexagesimally, to represent degrees and miles on Maps and Charts.

But the most correct scale of equal parts is the DIAGONAL SCALE (Fig. 2, Plate I.), the larger divisions of which are commonly an inch or half an inch, and sometimes a quarter of an inch, subdivided into one hundred equal parts. To construct this scale, draw eleven equidistant parallel lines; divide the upper of these lines A E into such a number of equal parts as the scale is intended to contain; from each of these divisions draw perpendicular lines through the eleven parallels to the line C F; subdivide the first of these divisions A B and C D into ten equal parts, and from the point C to the first division in the line A B, draw a diagonal right line, and lines parallel to this through each succeeding subdivision; then will each diagonal line, in passing from the line B A to D C, be one-tenth of the subdivisions further from the line D B, at the points where they intersect each succeeding parallel from B A to D C, that is, one hundredth of the larger divisions, by which means it is divided into one hundred equal parts

If, therefore, the larger divisions be accounted as units, the first subdivisions will be tenths, and the second, marked by the diagonals upon the parallels, hundredth parts; but if we suppose each of the larger divisions to represent ten, then the first subdivisions will be units, and the second tenths; or if the larger divisions be hundreds, then will the first subdivisions be tens, and the second units; so that the value of the subdivisions depends on that of the larger divisions.

The numbers 376, 37. 6, 3. 76, may therefore all be expressed by the same extent of the compasses: thus, setting one foot in the line marked 3 of the larger divisions, on the sixth parallel, and extending the other along the same parallel to the seventh diagonal, that distance will be the extent required; for if the three larger divisions be taken for 300 seven of the first subdivisions will be 70, which. upon the sixth parallel, taking in six of the second subdivisions for units. make the whole number 376; or if the three larger divisions be taken for 30, seven of the first subdivisions will be seven units, and the six subdivisions, upon the sixth parallel, will be six-tenths of a unit: lastly, if three larger divisions be esteemed as only 3, then will the first subdivisions be seven-tenths, and the six second subdivisions be the six-hundredth parts of a unit.

PROBLEM XI.

To construct Lines of Chords, Sines, &c.

Describe a semicircle A D B with any convenient radius (Fig. 3, Plate I.), and upon the centre C erect the perpendicular C D, continued at pleasure to F; through B draw B E parallel to C F, and draw the right lines A D and D B. Divide the quadrant D B into 9 equal parts, and with one foot of the compasses in B and the distances B 10, B 20, &c. transfer them to the right line B D, which will be a LINE OF CHORDS.

Divide the quadrant A D into 8 equal parts, and with one foot of the compasses in A, and the distance A 1, A 2, &c. transfer them to the right line A D, and it will be a LINE OF RHUMBS, containing eight points of the compass.

From the points 10, 20, 30, &c. in the arch B D, draw lines parallel to D C, which will divide the radius C B into a LINE OF SINES, reckoning from C to B, or of VERSED SINES, if it be numbered from B to C; which may be continued to 180, if the same divisions be transferred to the line C A, the other half of the diameter.

From the centre C draw right lines through the several divisions of the quadrant D B, until they cut the line B E, which will become a LINE OF TANGENTS.*

Transfer the distances between the centre C and the divisions on the line of tangents, to the line D F, and these will give the divisions of the LINE OF SECANTS, which must be numbered from D towards F.

From A draw right lines through the several divisions of the arch B D, and they will divide the radius C D into a LINE OF SEMI-TANGENTS, which are to be marked with the corresponding figures of the arch D B.

Divide the radius A C into 6 equal parts; through each of these draw lines parallel to C D, intersecting the arch A D; then, with one foot of the compasses in A, and the distances of the arch A 50, A 40, &c. transfer these to the right line A D, and it will give the divisions of the LINE OF LONGITUDE.

If this line be laid upon the scale close to the line of chords, so that 60 on the line of longitude be opposite 0 on the chords, and any degree of latitude be counted on the chords, there will stand opposite to it, on the line of longitude, the miles contained in one degree of longitude in that latitude; the measure of a degree at the Equator being 60 miles.

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[*] From the construction of the lines of chords, sines, and tangents, it is obvious that the chord of 60°, the sine of 90°, and the tangent of 45°, are all equal to the radius of the circle

CONSTRUCTION OF THE LINES
ON THE
PLANE SCALE &c.

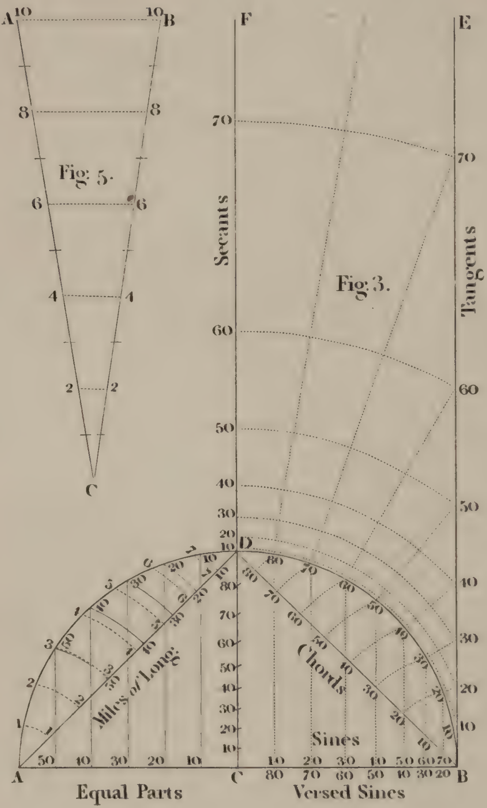


Fig: 4.

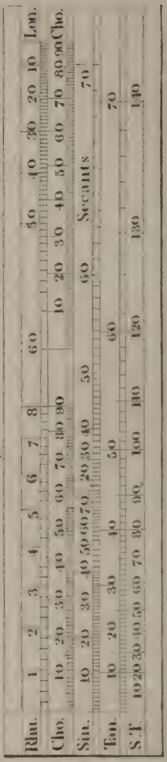


Fig: 1. *COMMON SCALE OF EQUAL PARTS.*

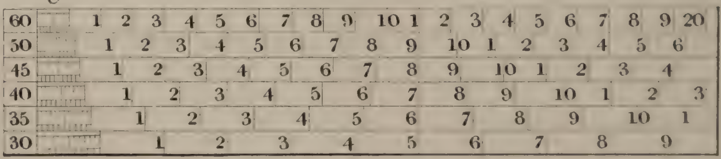
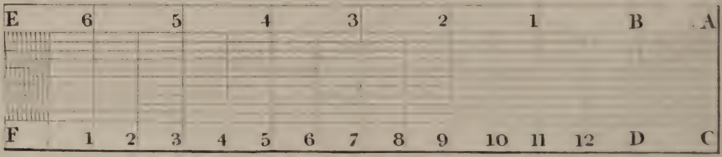


Fig: 2. *DIAGONAL SCALE OF EQUAL PARTS.*



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In the figure the divisions are given only to every tenth degree, and each point of the compass, which is sufficient to explain the method of Construction; but in Figure 4, these lines are graduated to degrees, and the rhumbs to quarters, and placed parallel, as exhibited on one side of a flat rule, which, with the scale of equal parts on the other side, constitutes the instrument called a Plane Scale.

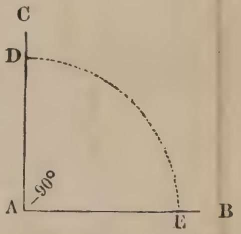
Besides the lines already mentioned, there are frequently on the Plane Scale a line of leagues, and a few other lines, which are only so many scales of equal parts, each having the equal divisions of different lengths, for the more readily laying down lines and figures of different lengths and magnitudes.

PROBLEM XII.

To make an Angle that shall contain any proposed Number of Degrees.

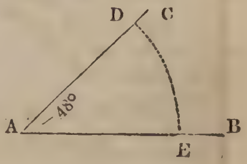
Case 1st. When the given angle is right, that is, contains 90 degrees.

Draw the line A B, and from the scale take the extent of the chord of 60 degrees in the compasses; then set one foot of the compasses in A, and with the other describe the arch E D, and set off thereon, from E to D, the distance of the chord of 90°; through A and D draw the right line A C, then will the angle B A C be a right angle. By this method a perpendicular may easily be raised on a given line, since the angle formed by one line that is perpendicular to another, is always a right angle



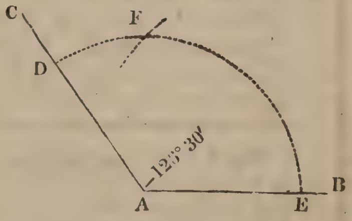
Case 2d. When the angle is to be acute; suppose one that shall contain 48 degrees.

Draw the line A B, and with one foot of the compasses in A (the chord of 60 degrees being taken as before), draw the arch E D, on which set off 48 degrees from E to D; through A and D draw the right line A C; then will the angle B A C be made, containing 48 degrees, as was required.



Case 3d. When the angle is to be obtuse; suppose one that shall contain 126° 30′.

Draw A B, and from the point A, with the chord of 60°, as before, draw the arch D E, and, as the divisions on the scale extend no further than 90°, first set off 90° from E to F; then set off the remainder, or excess above 90°, that is, 36° 30′, from F to D; through A and D draw the line A C, and the angle B A C will contain 126° 30′.



PROBLEM XIII.

To measure a given Angle B A C.

With one foot of the compasses in the angular point, and with the chord of 60 degrees, describe the arch D E (see the Figures in Problem XII.) cutting the legs in D and E; then the distance D E applied to the line of chords, from the beginning, will shew the measure of the angle B A C, if it contain less than 90 degrees; but when the arch exceeds that quantity, take 90 degrees from the line of chords, and set it off from E to F; then measure the excess D F, and their sum will give the measure of the angle required.

The construction of triangles will be explained in Trigonometry; but before the learner begin that subject, we would recommend him, if he have time, to study the use of Gunter's Scales and the Sector, as these instruments will afford him easy, elegant, and concise methods of resolving triangles.

DESCRIPTION AND USE OF GUNTER'S SCALES.

OF THE COMMON GUNTER.

This instrument is a flat rule, usually two feet in length, and about an inch and a half broad, having on one side equal parts, rhumbs, chords, &c. as on the Plane Scale: and on the other the logarithms of these numbers: hence the lines on this side are called logarithmic lines. They were invented by Mr. Edmund Gunter, who applied the logarithms of numbers, and of sines and tangents, to strait lines, by taking the lengths expressed by the figures in those logarithms from a scale of equal parts, and applying them to lines, as laid down on the Rule.

On the logarithmic side of the common Gunter are the eight following lines:

1. *A Line of Sine Rhumbs*, marked S. R., which contains the logarithms of the natural sines of every point and quarter point of the compass, numbered from the left hand towards the right, with 1, 2, 3, 4, 5, 6, 7, 8, where a brass pin is fixed.

2. *A Line of Tangent Rhumbs*, marked T. R., corresponding to the logarithms of the tangent of every point and quarter point of the compass. This line is numbered 1, 2, 3, 4, from left to right, and back again with 5, 6, 7, from the right towards the left. To take off any number of points below 4, we must reckon from the 1 towards the right hand; but any number of points above 4 we count towards the left hand.

3. *A Line of Numbers*, marked NUM., on which most of the others depend, contains the logarithms of numbers, and is figured from the left

hand of the scale towards the right to 1 or 10, near the middle of the scale; these divisions are subdivided into ten unequal parts, and these again into ten, five, or two parts, as room will permit: the whole of these divisions and subdivisions are repeated from the middle towards the right hand, being exactly of the same lengths, but ten times the value of the corresponding numbers in the first part.

If the 1 at the beginning of the line represent 1 unit, the next primary division, marked 2, will represent 2 units, and the middle 1 will be 10, the following 2 will be 20, the 3 will stand for 30, and so on, the 10 at the right hand representing 100. If the left hand 1 stands for 10, then the 2 will stand for 20, the 3 for 30, the middle 1 for 100, the following 2 for 200, and the 10 on the right hand for 1000; in like manner, if the first 1 be esteemed 1 tenth, the next following 2 will be 2 tenths, the middle 1 will be 1 unit, the next 2 will be 2 units, and the 10 at the end will be 10 units. Again, if the first 1 be counted 1 hundredth part, the next 2 will be 2 hundredth parts, the middle 1 will stand for 10 hundredth parts, or 1 tenth, the next 2 for 2 tenths, and the 10 at the end will stand for 1 unit, or whole number.

It is manifest that the value of the subdivisions must depend on that of the primary divisions; for, suppose the first 1 at the left hand be reckoned for 1 unit, then the first following principal subdivision will be 1 tenth, the second 2 tenths, and so on to the next primary division, which will represent 2 units; reckoning on in the same manner till you come to the middle 1, which will represent 10, then the next following principal subdivision will be 11, the next 12, where a brass pin is fixed; the next primary division 20, and so on to 100: and in the same way will the smaller subdivisions be valued.

As this line is of great importance, we shall add a few examples, to render what has been said the more clear. Suppose the point representing 25 be required:—the primary division 2 on either half is to be reckoned for 20; then counting forwards to the right, to the fifth principal subdivision, that point will represent 25, or 250, or 2500, &c. Again, let the point representing 146 be required. Here the 1 at the beginning, or in the middle, may be esteemed 100, the fourth principal subdivision on the right will then be 140, and because the interval between 140 and 150 is divided into 5 parts, each will be valued as 2; therefore, counting forwards 3 of these latter subdivisions, that point will represent 146.

Once more; suppose the place of 1785 be required:—the one at the beginning or middle is to be taken as 1000, the seventh following principal subdivision will be 1700; the fourth following smaller subdivision will be 1780, and the fourth part of the next smaller subdivision will be the point representing 1785.

4. *A Line of Sines*, marked SIN., beginning at the left hand, and numbered towards the right at each degree as far as 10, and then at each 10th degree to 90: the subdivisions under 10 degrees are usually 10 minutes; from 10 to 20 each is a quarter of a degree; from 20 to 40 each is half a degree; from 40 to 80 each is 1 degree; and from 80 to 90 each is 5 degrees.

5 *A Line of Versed Sines*, marked V. S.: it is numbered from the right towards the left, at each 10th degree as far as 160; the subdivisions from 20 to 90 are usually each two degrees; from 90 to 140 one degree; and from 140 to the end half a degree.

6 *A Line of Tangents*, marked TAN.: it is numbered from the left hand towards the right as far as 45 degrees, which is equal to radius, or the sine of 90 degrees; and, since the log. tangent of an arch above 45 degrees is the arithmetical complement of the tangent of an arch as much less than 45 degrees, the same division represents 40 or 50 degrees, 30 and 60, and so on; for if the line of tangents were continued beyond 45 on the right, the divisions would be exactly the same length, only reversing the order: therefore, instead of such continuation, it is more convenient to reckon the degrees above 45 backwards, or from right to left, observing at the same time that the degrees above 45 are to be supposed, when using the line, increasing towards the right hand, as in the other parts of the line.

The subdivisions on this line are nearly the same as on the line of sines; indeed these, as well as the other lines, are variously subdivided on different scales, according to the accuracy and goodness of the instrument.

7. *A Line of Meridional Parts*, marked MER., reckoned from right to left, each larger division representing 10 degrees, and the smaller each 1 degree, or 60 meridional miles.

8. *A Line of equal Parts*, marked E. P., numbered from right to left, each large division representing 10 degrees of the equator, or 600 miles. The first of these divisions is sometimes divided into 10 equal parts, each representing a degree, or 60 miles, and these again into halves or quarters of 30 or 15 miles each.

USE OF THE LINE OF NUMBERS.

Multiplication is performed on this line by extending the compasses from 1 to either of the factors*, and that extent will reach from the other factor to the product.

Suppose, for example, it were required to find the product of 16 multiplied by 5: set one foot of the compasses in 1, and the other in 5, then that extent will reach from 16 to 80, the product required.

When the product contains four figures, the fourth cannot be well ascertained by the scale, but it may be easily found by multiplying the unit figures of the factors, and the unit figure of their product will be that of the product required. For example, suppose it were required to find the product of 22 by 16; the extent from 1 to 16 will reach from 22 to about 350, but as the divisions are too small to distinguish the last figure, therefore multiply 2 by 6, which will give the product 12; hence the product required is 352.

Division being the reverse of Multiplication, extend from the divisor to 1, and that extent will reach from the dividend to the quotient.

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* The factors are numbers multiplied, of which one is called the multiplier, and the other the multiplicand.

Example—Divide 80 by 5. Extend from 5 to 1, and that extent will reach from 80 to 16, the quotient required.

To reduce a Vulgar Fraction to a Decimal, extend from the denominator to the numerator, and that extent will reach from 1 to the decimal fraction required.

Example—Required the decimal fraction equal to $\frac{3}{4}$. Extend from 4 to 3, and that extent will reach the same way from 1 to .75, the decimal required.

To perform the Rule of Three—State the question so that the first and third terms may be of the same name; then the fourth term will be of the same name with the second, and greater or less than the second, as the third is greater or less than the first; then extend the compasses from the first to the third term, and that extent will reach from the second to the fourth term.

Example—If a ship sail at the rate of 26 miles in 3 hours, how many miles will she sail in 24 hours?

Here, as 3 hours is to 26 miles, so is 24 hours to the answer; therefore, extend from 3 to 24, and that extent will reach from 26 to 208, the miles required.

To find the area, or superficial content of a square, or rectangle, extend from 1 to the breadth, and that extent will reach from the length to the superficial content.

Example—Suppose a board or plank measure 18 inches broad, and 25 feet in length, required the superficial content.

Extend from 1 to 1.5, (= 1 foot 6 inches), and that extent will reach from 25 feet to 37.5, or 37 feet 6 inches, the contents required.

To find the solid contents of a bale, box, chest, &c. or any other rectangular solid, extend from 1 to the breadth, and that extent will reach from the length to a fourth number; then extend from 1 to the depth, and that extent will reach from the fourth number to the solid contents.

Example—Required the solid contents of a box measuring 3 feet broad, 5.5 feet long, and 2 feet in depth.

Extend from 1 to 3, and that extent will reach from 5.5 to 16.5; then extend from 1 to 2, and that extent will reach from 16.5 to 33 feet, the solid contents

USE OF THE LINES OF SINES AND TANGENTS.

These lines are used with the line of numbers in working proportions Trigonometry, by the Rule above, as will be fully exemplified when treat on that subject.

USE OF THE LINE OF VERSED SINES.

This line is used with the line of sines in resolving a spherical triangle when the three sides are given to find the angles, or the three angles, to find the sides, as will be explained in the methods of working an azimuth.

USE OF THE LINES OF MERIDIONAL AND EQUAL PARTS.

These lines are always used together, and only in Mercator's Sailing, or in constructing a Mercator's Chart. When the meridional parts answering to a given latitude are required, they are found by taking the extent from the beginning of the line of meridional parts to the given latitude: this extent being applied to the line of equal parts will give, in degrees, the meridional parts required. Or, if the meridional difference of latitude between two places be wanted, the extent from one latitude to the other on the line of meridional parts will give, when applied to the line of equal parts, the meridional difference of latitude in degrees, which are to be reduced to miles.

OF THE SLIDING GUNTER.

This instrument is nearly of the same dimensions as the common Gunter, but consists of three pieces of wood; the extreme pieces being connected by thin plates of brass at each end, and the third made to slide in grooves between them. The lines on this scale are constructed and graduated as on the Plane Scale and common Gunter: we shall therefore only remark here, that there are two lines of numbers, sines, and tangents—one on the fixed part of the scale, and the other on the slide—and that there is likewise a third line of numbers on the slide opposite a line of sine rhumbs

USE OF THE LINE OF NUMBERS.

To perform Multiplication by these lines, set 1 on the sliding line to one of the factors on the fixed line; then opposite the other factor on the slide will be found the product on the fixed line.

Example—To find the product of 16 multiplied by 5, draw out the slide until 1, on its line of numbers, coincide with 5 on the fixed line; then opposite 16 on the sliding line, will be 80 on the fixed line.

Division is performed by drawing out the slide until the divisor on its line coincide with the dividend on the fixed line; then opposite to 1 on the sliding line will be the quotient on the fixed line.

Example—To divide 124 by 4, set 4 on the sliding line to coincide with 124 on the fixed line; then opposite to 1 on the slide will be 31 on the fixed line, which is the quotient required.

To work the Rule of Three, let the question be stated so that the first and third terms may be of the same name, then the fourth term will consequently be of the same name with the second, and greater or less than the second, as the third is greater or less than the first. Now, set the first term on the sliding line opposite to the third term on the fixed line, and the fourth term will be found on the fixed line, opposite to the third term on the sliding line.

Examples—If 3 yards of cloth cost 21 shillings. what will be the value of 27 yards? Now, as 3 yards : 21 shs. : : 27 yds. : the answer; therefore set 3 on the sliding line of numbers to 27 on the fixed line, then opposite to 21 on the sliding line will be found 189 on the fixed line, the fourth term or number of shillings required, equal to £9. 9s. Again, suppose a ship sail 170 miles in 24 hours, at what rate is that per hour? As 24 hrs. : 170 miles :: 1 hour : the answer. Set 24 on the sliding line of numbers to 1 on the fixed line; then opposite to 170 on the sliding line is $7\frac{1}{10}$ on the fixed line, the miles and parts that the ship sails per hour.

DESCRIPTION AND USE OF THE SECTOR

This instrument is formed of two equal rules or legs, moveable about a centre or joint, on the faces of which are drawn several lines or scales, some proceeding from the centre, called sectoral lines, and others parallel to the edge of the rules, similar to those laid down upon a common Gunter.

The sectoral lines are drawn twice on the same face of the instrument, that is, once on each leg; those on one face are, 1. Two scales of equal parts, marked Lin. or L.; each of these scales, from the great extensiveness of its use, is called the Line of Lines. 2. Two lines of chords, marked Cho. or C. 3. Two lines of secants marked Sec. or S. 4. Two lines of polygons, marked Pol.—Upon the other face the sectoral lines are, 1. Two lines of sines, marked Sin. or S. 2. Two lines of tangents, marked Tan. or T. 3. Between the lines of tangents and sines, two other lines of tangents, marked *t*, to a less radius, to supply the defect of the former, and extending from 45 to about 75 degrees.

The lines of chords, sines, tangents, and secants, are constructed upon the same principle as those on the Plane Scale, making the length of the line of chords the radius of the circle. (See Geom. Prob. XI.)

Each pair of the sectoral lines (except the line of polygons) are numbered from the centre, and so disposed as to make equal angles at the centre, consequently at whatever distance the Sector be opened, the angles will always be respectively equal; that is, the distance between 10 and 10 on the lines of lines will be equal to 60 and 60 on the lines of chords, 90 and 90 on the lines of sines, and 45 and 45 on the lines of tangents.

The other lines on the Sector being for the most part such as are usually drawn upon the Gunter's Scale, which have already been described, it will be unnecessary here to enumerate them; we shall therefore only observe that the logarithmic lines, being placed partly on one leg, and partly on the other, are to be used with the legs fully opened.

The use of the sectoral lines is founded on a property of similar triangles, namely, that their corresponding sides are proportional. Let c b, c a, (Fig. 5, Plate I.) represent a pair of sectoral lines, forming the angle a c b; divide them each into any number of equal parts, as ten for instance, and draw lines to the corresponding numbers on each line, as from 2 to 2, 4 to 4, &c. These lines will form a series of triangles, as C 2 2, C 4 4, &c. all similar to the triangle C A B; therefore it will be, as C 2 is to C A, so is 2 2 to 10 10, or A B; and as C 2 is to 2 2, so is C A to A B, and so on for the other corresponding lines.

Hence also if the lines C A, C B, represent the lines of chords, sines, tangents, or secants; and if C A be the radius, and the line C 2 the chord, sine, tangent, or secant, of any proposed number of degrees; then the line 2 2 will be the chord, sine, &c. of the same number of degrees to the radius A B.

We shall now proceed to explain some of the most important uses to which the sectoral lines may be applied; previous to which it will be necessary to observe, that in all operations the distances are to be taken with a pair of compasses from the innermost of the three lines which bound the divisions, that being the line proceeding from the centre: it is likewise to be understood, that the measure taken from the centre to any part of a sectoral line, is called a *lateral distance*, and that the measure taken from any point in one line to its corresponding point in a line of the same name, is called a *transverse*, or *parallel distance*

USE OF THE LINES OF LINES.

1. *To divide a given line into any number of equal parts:* for example suppose 9. Take the length of the given line in the compasses, and make it a transverse distance from 9 to 9, the number of parts proposed; then will the transverse distance of 1 and 1 be one of the equal parts, or the 9th part of the whole; and the transverse distance of 2 and 2 will be 2 of the equal parts, or $\frac{2}{9}$ of the whole line, and so on.

Note.—When the line to be divided is too long to be applied to the legs of the Sector, take some aliquot part of it, as the half, the third, &c. and double or triple the lengths of the transverse distances taken from the Sector.

2. *To divide a given line into any number of parts that shall be in any assigned proportion;* as, suppose three parts, in the proportion of 2, 3, and 4. Make the given line a transverse distance to 9, the sum of the proposed numbers 2, 3, 4; then the transverse distances of these numbers severally will be the parts required.

3. *To find a fourth proportional to three given lines or numbers;* as, uppose to 8, 4, and 6. Take the lateral distance of 4 in the compasses, nd make it the transverse distance of 8; then the transverse distance of 6, tended from the centre, will reach to the fourth proportional 3. If a ship il 36 miles in 4 hours, what distance will she sail in 7 hours? Open the ector till the transverse distance of 4 and 4 be equal to the lateral distance 36; then the transverse distance of 7 laid off from the centre will give 63, the fourth proportional.

Suppose three lines A B, C D, and E F, given to find a fourth proportional. Take the length of the line A B in the compasses, and placing one foot in the centre, mark what point or division the other foot falls on: open the Sector till the parallel distance between that point and the corresponding one on the other leg is equal to the line C D; then E F taken in the compasses and laid off as a lateral distance, the corresponding transverse distance will be the length of the line required.

Let it be required to reduce a chart drawn on a scale of 5 inches to a degree, to a scale of 3 inches to a degree. Make the transverse distance from 5 to 5 equal to the lateral distance of 3; the legs of the Sector being kept at this angular position, any measure taken from the chart being laid off as a lateral distance, the corresponding transverse distance will be the measure to be laid down upon the reduced chart.

4. *Having a line containing any given number of equal parts, to find the length of a line containing any other number of the same parts.*

Suppose a chart to be drawn on a scale of 5 miles to 3 inches; required the length of any other number of miles upon the same scale. Make the transverse distance of 5 and 5 equal to 3 inches; the legs of the Sector being kept at this angular position, the transverse distance of any other number, within the limits of the Sector, will be the length of the number of miles required.

5. *Having the number of parts contained in any given line, to find the number of the same parts contained in another line.*

Suppose the length of one side of a triangle measure 30, what are the measures of the other sides? Take the length of the given side in the compasses, and apply it transversely from 30 to 30; to this opening of the Sector apply the length of the other sides transversely, so that the points may fall upon corresponding divisions, and these will shew the measure of the sides required.

USE OF THE LINES OF CHORDS.

1. *To protract or lay down an angle of any given number of degrees.* At any opening of the Sector take the transverse distance of 60°, with which extent describe an arch; then take the transverse distance of the proposed number of degrees, and apply it to that arch: through the extremities of this distance on the arch, draw two lines from the centre, and they will form the angle required. When the angle exceeds 60°, lay it off at twice or thrice.

In this manner any number of degrees may be laid off on the circumference of a given circle, making the transverse distance of 60° equal to the radius of the circle.

2. *To measure any given angle.* With any radius describe an arch from the angular point, and set that radius transversely from 60 to 60; then take the length of the intercepted arch in the compasses, and apply it transversely to the line of chords, so that the points of the compasses may fall upon corresponding divisions, and they will shew the measure of the given angle.

USE OF THE LINES OF SINES, TANGENTS, AND SECANTS.

1. *Having the length of the radius of a circle, to find the length of the chord, sine, or tangent of any arch of that circle.* Suppose the chord, sine, or tangent of 30 degrees to a radius of 2 inches be required· open the Sector till the transverse distance of 60 and 60 on the lines of chords be equal to 2 inches; then will the same extent reach from 45 to 45 on the lines of tangents, and from 90 to 90 on the lines of sines, so that to whatever radius the lines of chords are set, to the same are all the others set. In this angular position of the legs, therefore, if the transverse distance between 30 and 30 be taken on the lines of chords, sines, or tangents, with the compasses, it will give the length of the chord, sine, or tangent of 30 degrees, to the radius of 2 inches. When the required chord is above 60°, or the tangent above 45°, as suppose 70 degrees, proceed thus: for the chord take the transverse distance of half the arch, *viz.* 35 degrees, on the line of sines, the double of which gives the length of the chord of 70 degrees. To find the tangent of 70 degrees to the same radius, make the transverse distance from 45 to 45, on the upper lines of tangents, equal to 2 inches; then the extent between 70 and 70 on the same lines will be the length of the tangent required.

2. *Having the radius of a circle, to find the secant of any arch of that circle:* as again, suppose of 20 or 70 degrees, to a radius of 2 inches; make 2 inches the transverse distance between 0 and 0 on the lines of secants; then will the transverse distance of 20 and 20, or 70 and 70, give the secant of 20 or 70 degrees.

3. *The radius of a circle, and any line representing a sine, tangent, or secant of an arch of that circle being given, to find the degrees and parts corresponding to that line.* Open the Sector to the given radius, according as a sine, tangent, or secant is concerned, then, taking the given line in the compasses, apply the legs transversely till they fall on the corresponding divisions of the proper line, and these will point out the degrees and parts required.

In this manner the angles of a right-angled triangle may be estimated, by considering one side as the radius of a circle, and one of the other sides as representing the sine, tangent, or secant of the required angle.

The sectoral lines are likewise useful in working proportions in Trigonometry: suppose, for example, the hypothenuse of a triangle measures 56, and the angle opposite the perpendicular 32 degrees; to find the perpendicular, the proportion will be, as radius, or sine of 90° is to the hypothenuse 56, so is sine of the angle opposite the perpendicular 32° to the perpendicular; therefore make the transverse distance of 90 and 90 on the lines of sines equal to the lateral distance 56 on the lines of lines; then the transverse distance of 32° on the line of sines, applied as a lateral distance to the lines of lines, will give 29.5 for the length of the perpendicular required.

PLANE TRIGONOMETRY

PLANE TRIGONOMETRY is that branch of Geometry which teaches to compute the sides and angles of plane triangles; it is divided into right-angled and oblique-angled Trigonometry, according as it is applied to the mensuration of right or oblique-angled triangles.

RIGHT-ANGLED TRIGONOMETRY.

DEFINITIONS AND PRINCIPLES.

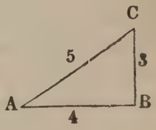
1 Every triangle consists of six parts; namely, three sides and three angles.

2. The sum of the three angles of every plane triangle is equal to two right angles, or 180 degrees; hence, if one of the angles be known, the sum of the other two may be found by subtracting the given angle from 180 degrees: also, if two of the angles be known, their sum, subtracted from 180 degrees, will give the third angle: again, in a right-angled triangle (the right angle containing 90 degrees), the sum of the two acute angles is equal to 90 degrees: therefore, if one of the acute angles be given, the other will be found by subtracting the given angle from 90 degrees.

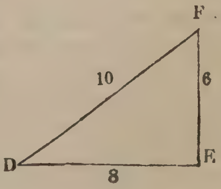
3. Any two sides of a triangle added together are greater than the third side.

4. The greatest side of a triangle is opposite the greatest angle, and the least side opposite the least angle; also, in the same triangle, equal sides are opposite to equal angles.

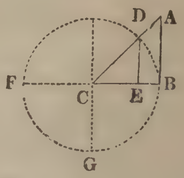
5. Two triangles are said to be similar when all the angles of the one are respectively equal to all the angles of the other; as for instance, the triangle A B C is similar to the triangle D E F, because the angles A, B, and C, are respectively equal to the angles D, E, and F.



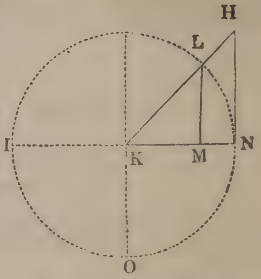
6. The sides of similar triangles, opposite to equal angles, are proportional; thus in the triangles A B C and D E F, as A B is to D E, so is A C to D F. and so is B C to E F. Or as 4 : 8 :: 5 : 10 :: 3 : 6.



7. Similar arches of unequal circles are such as contain the same number of degrees, &c. of their respective circles.



8. The sines, tangents, and secants of similar arches are proportional to the radii of the circles; thus, supposing the arch D B, of the circle D B G F, to be similar to the arch L N, of the circle L N O I, then D E is to L M, A B to H N, and C A to K H, as C B or C D is to K N or K L; that is, the sine, tangent and secant of one arch is to the sine, tangent, and secant of the other, as the radius of one circle is to the radius of the other.



Hence, if the radius of a circle be divided into a certain number of equal parts, and the length of the sine, tangent, or secant of any angle in such parts be given, the length of the sine, tangent, or secant of the same angle to any other radius may be found.

9. The lengths of the sine, tangent, and secant for every degree and minute of the quadrant, whose radius is 1, being calculated and arranged in a table, is called a TRIGONOMETRICAL CANON: and the logarithms of these lengths are called logarithmic or artificial sines, tangents, and secants; as in Table XXV. of this Work.

From these Principles are deduced the following

RULES

For computing the Sides and Angles of right-angled Triangles.

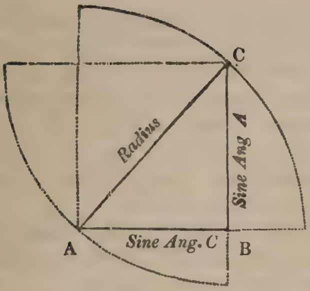
In every right-angled triangle there must be two parts given, besides the right angle, to find the other three; and one of these parts at least must be a side, because the angles will only give the proportion, not the absolute length of the sides.

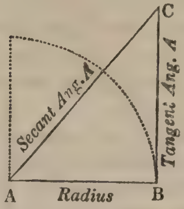
In every right-angled triangle one of the sides must be considered as representing the radius of a circle; then,

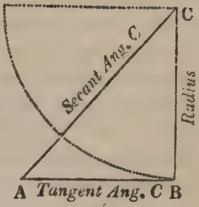
1. If the *Hypothenuse* be made radius, the perpendicular and base will each be the sine of its opposite angle.

2. If the *Base* be made radius, the perpendicular will be the tangent of its opposite angle, and the hypothenuse the secant of the same angle.

3. If the *Perpendicular* be made radius, the base will be the tangent of its opposite angle, and the hypothenuse the secant of the same angle; the sine, tangent, or secant of one angle being, in each case, the co. sine, co tangent, or co. secant of the other.







Thus, if in the triangles A B C, the hypothenuse A C be considered as radius of a circle, then it is evident the perpendicular B C will be the sine of the angle A, and the base A B the sine of the angle C; if the base A B be made radius, then the perpendicular B C will be the tangent of the angle A, and the hypothenuse A C the secant of angle A; if the perpendicular B C be made radius, then the base A B will be the tangent of the angle C, and the hypothenuse the secant of angle C

Since the acute angles A and C contain together 90 degrees, they are the complements of each other; therefore the sine, tangent, and secant of angle A is the co. sine, co. tangent, and co. secant of angle C; and the sine, &c. of angle C is the co. sine, &c. of angle A. (See Definition XXXIV. Geom.)

To find a Side.

Consider any one of the sides as representing the radius of a circle, and write upon it the word *radius;* then upon the other sides write the parts they represent according to the preceding Rules, which call the *names* of the sides; then say,

As the name of the given side
Is to the given side,
So is the name of the side required
To the side required.

To find an Angle.

Consider one of the given sides as representing the radius of a circle, and write upon it the word *radius;* and upon the other sides write the parts they represent according to the preceding Rules; then say,

As the side representing radius
Is to radius,
So is the other given side
To the sine, tangent, or secant of the angle by it represented

Having raised the canons, or proportions, they may be worked by the common Rule of Three, taking the lengths of the sines, tangents, or secants of the angles, to Radius 1, from the proper Table; but as logarithms considerably abbreviate the calculation, by performing Multiplication by Addition, and Division by Subtraction, it is more usual to take out the logarithms of the three given terms (the logarithm of radius being 10.00000), then, adding the logarithms of the second and third terms together, and from their sum subtracting the logarithm of the first term, the remainder will be the logarithm of the fourth term, which being found in the proper Table, the number, or the degrees and minutes corresponding to it, will give the required side or angle.

NOTE. The logarithms for sides are to be taken from Table XXIV., and for the sines, tangents, or secants of angles, from Table XXV.

We shall now proceed to exemplify the above Rules by the following Cases, which we shall resolve by three different methods: *viz.* by Geometrical Construction, by Logarithmic Calculation and by Gunter's Scale.

CASE I.

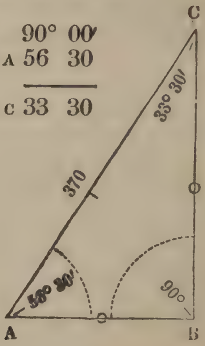
The Angles and the Hypothenuse given, to find the Base and the Perpendicular.

EXAMPLE. Given the hypothenuse A C, 370 miles, (or any other measure of length), the angle A 56° 30′, and consequently the angle C 33° 30′; required the base A B and perpendicular B C.

BY CONSTRUCTION.

Draw the line A B of any length, and make the angle at A 56° 30′ (Problem XII. Geometry); from A to C lay off 370, the length of the hypothenuse, taken from any convenient scale of equal parts, and from the point C let fall the perpendicular C B (Prob. III. Geom.); then A B C is the triangle required: the base A B, measured on the same scale of equal parts by which the hypothenuse was measured, will be 204. 2, and the perpendicular B C 308. 5.

	90°	00′
Angle A	56	30
Angle C	33	30



BY CALCULATION.

Making the hypothenuse radius, A B will be the sine of angle C, and C B the sine of angle A; then,

To find the Base A B.

As radius	10. 00000
Is to hypoth. AC 370	2. 56820
So is sine ang. C 33° 30′	9. 74189
	12. 31009
	10. 00000
To the base AB 204. 2	2. 31009

To find the Perpendicular B C.

As radius	10. 00000
Is to hypoth. AC 370	2. 56820
So is sine ang. A 56° 30′	9. 92111
	12. 48931
	10. 00000
To the perpend. BC 308. 5	2. 48931

Making the base radius, B C will be the tangent, and A C the secant of angle A; then

To find the Base.

As sec. of ang. A 56° 30′	10. 25811
Is to hypoth. A C 370	2. 56820
So is radius	10. 00000
	12. 56820
	10. 25811
To the base A B 204. 2	2. 31009

To find the Perpendicular.

As sec. of ang. A 56° 30′	10. 25811
Is to hypoth. A C 370	2. 56820
So is tan. of ang. A 56° 30′	10. 17922
	12. 74742
	10. 25811
To the perpend. B C 308. 5	2. 48931

Making the perpendicular radius, A B will be the tangent, and A C the secant, of angle C; then,

To find the Base.

As sec. of ang. C 33° 30	10. 07889
Is to hypoth. A C 370	2. 56820
So is tan. ang. C 33° 30′	9. 82078
	12. 38898
	10. 07889
To the base A B 204. 2	2. 31009

To find the Perpendicular.

As sec. of ang. C 33° 30′	10. 07889
Is to hypoth. A C 370	2. 56820
So is radius	10. 00000
	12. 56820
	10. 07889
To the perpend. B C 308. 5	2. 48931

BY GUNTER'S SCALE.*

1st. Extend the compasses from radius†, or 90°, to angle C 33° 30′ on the line of sines, and that extent will reach from the hypothenuse 370 to 204. 2, the measure of the base, on the line of numbers

2dly. Extend the compasses from radius, or 90°, to angle A 56° 30′ on the line of sines, and that extent will reach from the hypothenuse 370 to 308. 5, the measure of the perpendicular, on the line of numbers.

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* In working the several Cases by Gunter's Scale, we shall always suppose the hypothenuse radius, where it can be done, being the most simple of the three.

† Radius, on Gunter's Scale, is either 8 points on the line of sine rhumbs, 4 points on the line of tangent rhumbs, 90 degrees on the line of sines, or 45 degrees on the line of tangents

CASE II

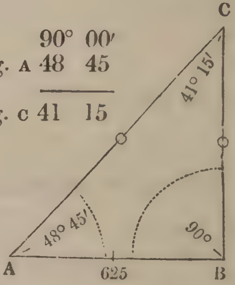
The Angles and one of the Legs given, to find the Hypothenuse and the other Leg.

Example. Given the base A B 625, and the angle A 48° 45′, to find the hypothenuse A C, and the perpendicular B C.

BY CONSTRUCTION.

Draw the base A B, which make equal to 625, taken from a scale of equal parts; and upon B erect the perpendicular B C (Prob. II. or XII. Geom.); make the angle A equal to 48° 45′ (Prob. XII. Geom.), and draw the hypothenuse A C to cut the perpendicular B C in the point C; then A C, measured on the same scale of equal parts that A B was, will be 947.9, and B C 712.7.

	90°	00′
Ang. A	48	45
Ang. C	41	15



BY CALCULATION.

Making the hypothenuse radius, A B will be the sine of angle C, and C B the sine of angle A; then,

To find the Hypothenuse.		*To find the Perpendicular*	
As sine of ang. C 41° 15′	9.81911	As sine of ang. C 41° 15′	9.81911
Is to the base A B 625	2.79588	Is to the base A B 625	2.79588
So is radius	10.00000	So is sine of ang. A 48° 45′	9.87612
	12.79588		12.67200
	9.81911		9.81911
To the hypoth. A C 947.9	2.97677	To the perpend. B C 712.7	2.85289

Making the base radius, B C will be the tangent, and A C the secant, of angle A; then,

To find the Hypothenuse.		*To find the Perpendicular.*	
As radius	10.00000	As radius	10.00000
Is to the base A B 625	2.79588	Is to the base A B 625	2.79588
So is the sec. of ang. A 48° 45′	10.18089	So is tan. of ang. A 48° 45′	10.05701
	12.97677		12.85289
	10.00000		10.00000
To the hypoth. A C 947.9	2.97677	To the perpend. B C 712.7	2.85289

Making the perpendicular radius, A B will be tangent, and A C secant, of angle C; then,

To find the Hypothenuse.		*To find the Perpendicular.*	
As tang. of ang. C 41° 15′	9.94299	As tang. of ang. C 41° 15′	9.94299
Is to the base A B 625	2.79588	Is to the base A B 625	2.79588
So is sec. of ang. C 41° 15′	10.12387	So is radius	10.00000
	12.91975		12.79588
	9.94299		9.94299
To the hypoth. A C 947.9	2.97676	To the perpend. B C 712.7	2.85289

BY GUNTER'S SCALE.

1st. Extend the compasses from angle C 41° 15′ to radius, or 90° on the line of sines, and that extent will reach from the base 625 to the hypothenuse 947.9 on the line of numbers.

2dly. Extend the compasses from angle C 41° 15′ to angle A 48° 45′ on the line of sines, and that extent will reach from the base 625 to the perpendicular 712.7 on the line of numbers.

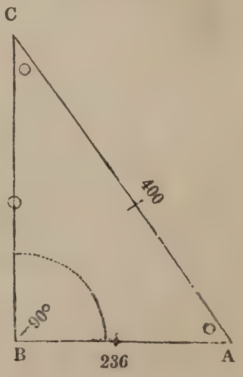
CASE III.

The Hypothenuse and one Leg given, to find the Angles and the other Leg.

EXAMPLE. Given the hypothenuse A C 400, and the base B A 236; required the angles A and C, and the perpendicular B C

BY CONSTRUCTION.

Draw the base B A, which make equal to 236; upon B erect the perpendicular B C, (Prob. II. or XII. Geom.), and taking the distance 400 in the compasses, place one foot in A, and let the other foot cross B C in C, and draw the line A C; then will the perpendicular B C measure 323, the angle C 36° 9′, and the angle A 53° 51′ (Prob. XIII. Geom.)



BY CALCULATION

Making the hypothenuse radius, B A will be the sine of angle C, and B C, the sine of angle A; then,

To find the Angles.		*To find the Perpendicular.*	
As the hypoth. A C 400	2.60206	As radius	10.00000
Is to radius	10.00000	Is to the hypoth. A C 400	2.60206
So is the base B A 236	2.37291	So is sine of ang. A 53° 51′	9.90713
	12.37291		12.50919
	2.60206		10.00000
To sine of ang. C 36° 9′	9.77085	To the perpend. B C 323	2.50919
90 0			
Angle A 53 51			

Making the base radius, B C will be the tangent, and A C the secant, of angle A; then,

To find the Angles.		*To find the Perpendicular.*	
As the base B A 236	2.37291	As radius	10.00000
Is to radius	10.00000	Is to the base B A 236	2.37291
So is the hypoth. 400	2.60206	So is tan. of ang. A 53° 51′	10.13635
	12.60206		12.50926
	2.37291		10.00000
To sec. of ang. A 53° 51′	10.22915	To the perpend. B C 323	2.50926
90 00			
Angle C 36 9			

BY GUNTER'S SCALE.

1st. Extend from the hypothenuse 400 to the base 236 on the line of numbers, and that extent will reach from radius 90° to angle C 36° 9′ on the line of sines; hence the angle A will be 53° 51′.

2dly. Extend from radius 90° to angle A 53° 51′ on the line of sines, and that extent will reach from the hypothenuse 400 to the perpendicular 323 on the line of numbers.

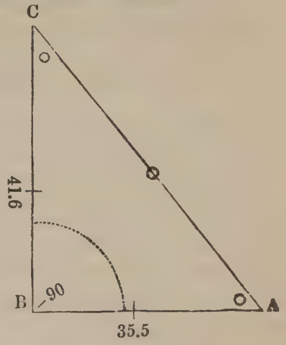
NOTE. The perpendicular may be found, independent of the angles, thus: subtract the square of the base from the square of the hypothenuse; the square root of the remainder will be the length of the perpendicular required.

CASE IV.

The Base and Perpendicular given, to find the Angles and the Hypothenuse.

Example. Given the base B A 35. 5, and the perpendicular B C 41. 6; quired the angles A and C, and the hypothenuse A C.

BY CONSTRUCTION.



Draw the line B A, and upon B raise the perpendicular B C (Prob. II. or XII. Geom.); make B A equal to 35. 5, and B C equal to 41. 6, and draw the line A C; then the hypothenuse A C will measure 54. 7, the angle A 49° 31′, and the angle C 40° 29′ (Prob. XIII. Geom.).

BY CALCULATION.

Making the base radius, B C will be the tangent, and A C the secant, of angle A.

To find the Angles.		*To find the Hypothenuse.*	
As the base B A 35. 5	1. 55023	As radius	10. 00000
Is to radius	10. 00000	Is to the base B A 35. 5	1. 55023
So is the perpend. B C 41. 6	1. 61909	So is sec. of ang. A 49° 31′	10. 18760
	11. 61909		11. 73783
	1. 55023		10. 00000
To tan. of ang. A 49° 31′	10. 06886	To the hypoth. A C 54. 68	1. 73783
90 00			
Angle C 40 29			

Making the perpendicular radius, B A will be the tangent, and A C the secant, of angle C.

To find the Angles.		*To find the Hypothenuse*	
As the perpend. B C 41. 6	1. 61909	As radius	10. 00000
Is to radius	10. 00000	Is to perpend. B C 41. 6	1. 61909
So is the base B A 35. 5	1. 55023	So is sec. of ang. C 40° 29′	10. 11885
	11. 55023		11. 73794
	1. 61909		10. 00000
To tan. of ang. C 40° 29′	9. 93114	To the hypoth. A C 54. 69	1. 73794
90 00			
Angle A 49 31			

BY GUNTER'S SCALE.

1st. Extend the compasses from the base 35. 5 to the perpendicular 41. 6 on the line of numbers, and that extent will reach from radius 45° to angle A 49° 31′ on the line of tangents*: hence angle C will be 40° 29′.

2dly. Extend the compasses from angle C 40° 29′ to radius 90° on the line of sines, and that extent will reach from the base 35. 5 to the hypothenuse 54. 68 on the line of numbers.

EXAMPLES FOR EXERCISE.

1. Given the hypothenuse 108, and the angle opposite the perpendicular 25° 36′; required the base and perpendicular.

Answer. The base is 97. 4, and the perpendicular 46. 66.

2. Given the base 96, and its opposite angle 71° 45′; required the perpendicular and the hypothenuse.

Answer. The perpendicular is 31. 66, and the hypothenuse 101. 1.

3. Given the perpendicular 360, and its opposite angle 58° 20′; required the base and the hypothenuse.

Answer. The base is 222, and the hypothenuse 423.

4. Given the base 720, and the hypothenuse 980; required the angles and the perpendicular.

Answer. The angles are 47° 17′ and 42° 43′, and the perpendicular 664. 8.

5. Given the perpendicular 110. 3, and the hypothenuse 176. 5; required the angles and the base.

Answer. The angles are 38° 41′ and 51° 19′, and the base 137. 8

6. Given the base 360, and the perpendicular 480; required the angles and the hypothenuse.

Answer. The angles are 53° 8′ and 36° 52′, and the hypothenuse 600.

7. Given the base 346. 5, and the adjacent angle 35° 24′; required the perpendicular and hypothenuse.

Answer. The perpendicular 246. 2, and the hypothenuse 425. 1.

8. Given the hypothenuse 36. 5, and the angle opposite the base 65° 15′; required the perpendicular and base.

Answer. The perpendicular 15. 28, and the base 33. 15.

9. Given the perpendicular 725, and the adjacent angle 21° 36′; requred the base and hypothenuse.

Answer. The base 287. 1, and the hypothenuse 779. 8.

10. Given the base 32. 76, and the hypothenuse 56. 95; required the angles and the perpendicular.

Answer. The angles are 35° 7′ and 54° 53′, and the perpendicular 46. 58.

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* The same point represents both 49° 31′ and 40° 29′; but as the third term is more than the first, the angle A, or fourth term, will consequently be more than 45°, which is radius, or the second term on the line of tangents.

11. Given the perpendicular 98.4, and the hypothenuse 1013; required the angles and the base.

Answer. The angles are 5° 34′ and 84° 26′, and the base 1009.

12. Given the base 4567, and the perpendicular 3251; required the angles and the hypothenuse.

Answer. The angles are 35° 27′ and 54° 33′, and the hypothenuse 5606

OBLIQUE-ANGLED TRIGONOMETRY.

RULES

For computing the Sides and Angles of Oblique-angled Triangles.

I. *When two of the three given Parts are a Side, and its opposite Angle*

To find a Side.

As the sine of any given angle
Is to its opposite side,
So is the sine of any other given angle
To its opposite side.

To find an Angle.

As any given side
Is to the sine of its opposite angle.
So is any other given side
To the sine of its opposite angle.

When the given side, opposite the given angle, is greater than the other given side, then the angle opposite that other given side, is always acute; but when the given side, opposite the given angle, is less than the other given side, then the angle opposite that other given side may be either acute or obtuse, which consequently must be determined from the nature of the triangle.

II. *When two Sides and the Angle contained between them are given.*

As the sum of the two given sides
Is to their difference,
So is the tangent of half the sum of the unknown angles
To the tangent of half their difference:

This half difference added to half the sum of the unknown angles, gives the greater angle, and subtracted, leaves the less angle. The angles being thus all known, the remaining side is to be found by Rule I.

III. *When the three Sides are given, to find the Angles.*

As the base, or greatest side,
Is to the sum of the other two sides,
So is the difference of those sides,
To the difference of the segments made by a perpendicular
let fall from the greatest angle upon the base.

Then half this difference added to half the sum of the segments—that is, half the base—gives the greater segment, and subtracted, gives the less segment. Hence the triangle will be divided into two right-angled triangles, in each of which there will be given the hypothenuse and the base, to find the other angles, which may be done by Rule I., or by those in Right-angled Trigonometry.

CASE I.

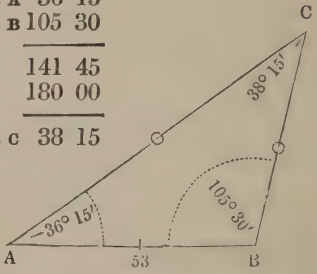
The Angles and one Side given, to find the other Sides.

EXAMPLE. Given the angle A 36° 15′, the angle B 105° 30′, and the side A B 53; required the sides A C and B C.

BY CONSTRUCTION.

Ang. A	36°	15′
Ang. B	105	30
Sum	141	45
	180	00
Ang. C	38	15

Draw the line A B, and make it equal to 53; make the angle B A C 36° 15′, and the angle A B C 105° 30′, (Prob. XII. Geom.), and draw the lines A C and B C till they meet in C; then A C will measure 82. 5, and B C 50. 62.



BY CALCULATION.

To find the Side A C by Rule I.

As sine of ang. C 38° 15′	9. 79176
Is to the side A B 53	1. 72428
So is sine of ang. B[*] 105° 30′	9. 98391
	11. 70819
	9. 79176
To the side A C 82. 5	1. 91643

To find the Side B C by Rule I.

As sine of ang. C 38° 15′	9. 79176
Is to the side A B 53	1. 72428
So is sine of ang. A 36° 15′	9. 77181
	11. 49609
	9. 79176
To the side B C 50. 62	1. 70433

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[*] For the manner of finding the log. sine of 105° 30′, see Explanation of Table XXV.

BY GUNTER'S SCALE.

1st. Extend the compasses from the angle C 38° 15′ to 74° 30′, the supplement of angle B, on the line of sines, and that extent will reach from the side A B 53 to the side A C 82. 5 on the line of numbers.

2d. Extend the compasses from the angle C 38° 15′ to the angle A 36° 15′ on the line of sines, and that extent will reach from the side A B 53 to the side B C 50. 6 on the line of numbers.

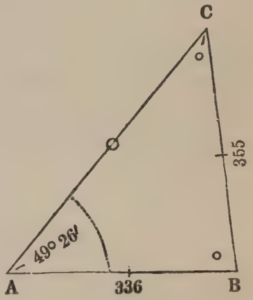
CASE II.

Two Sides and an Angle opposite one of them given, to find the other Angles and the third Side.

Example. Given the side A B 336, the side B C 355, and the angle A 49° 26′; required the angles B and C, and the side A C.

BY CONSTRUCTION.

Draw the line A B, which make equal to 336; draw the line A C so as to make an angle of 49° 26′ with A B (Prob. XII. Geom.); take the length of B C in the compasses, and setting one foot in B, let the other cut the line A C in C, and draw the line B C; then the angle B will measure 84° 36′, the angle C 45° 58′ (Prob. XIII Geom.), and the side A C 465. 3.



BY CALCULATION.

To find the Angle C by Rule I.	
As the side B C 355	2. 55023
Is to sine of ang. A 49° 26′	9. 88061
So is the side A B 336	2. 52634
	12. 40695
	2. 55023
To sine of ang. C 45° 58′	9. 85672
Ang. A 49 26	
Sum 95 24	
180 00	
Ang. B 84 36	

To find the Side A C by Rule I.	
As sine of ang. A 49° 26′	9. 88061
Is to the side B C 355	2. 55023
So is sine of ang. B 84° 36′	9. 99807
	12. 54830
	9. 88061
To the side A C 465. 3	2. 66769

BY GUNTER'S SCALE.

1st. Extend the compasses from the side B C 355 to the side A B 336 on the line of numbers, and that extent will reach from angle A 49° 26′ to angle C 45° 58′ on the line of sines; hence the angle B is 84° 36′.

2d Extend the compasses from the angle A 49° 26′ to the angle B 84° 36′ on the line of sines; and that extent will reach from the side B C 355 to the side A C 465. 3 on the line of numbers.

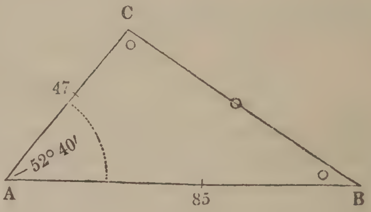
CASE III.

Two Sides and their contained Angle given, to find the other Angles and the third Side.

Example. Given the side A B 85, the side A C 47, and the angle A 52° 40′ : required the angles C and B, and the side B C.

BY CONSTRUCTION.

Draw the line A B, and make it equal to 85; at A make the angle B A C 52° 40′ (Prob. XII. Geom.); from A to C lay off 47, and draw the line B C; then A B C is the triangle required; the angle B will measure 33° 29′, the angle C 93° 51′ (Prob. XIII. Geom.), and the side B C 67. 7.



BY CALCULATION.

To find the Angles by Rule II.

Side A B		85
Side A C		47
Sum		132
Diff		38
	180°	00′
Angle A	52	40
Sum of ang. B & C	127	20
Half sum	63	40

As the sum of the sides A B, A C,	132	2. 12057
Is to their difference	38	1. 57978
So is tang. of half the sum of angles B and C	63° 40′	10. 30543
		11. 88521
		2. 12057
To tang. of half their diff.	30° 11′	9. 76464
Sum gives the greater ang. C	93 51	
Diff. gives the less ang. B	33 29	

To find the Side B C by Rule I

As sine of ang. B	33° 29′	9. 74170
Is to the side A C	47	1. 67210
So is sine of angle A	52° 40′	9. 90043
		11. 57253
		9. 74170
To the side B C 67. 74		1. 83083

NOTE. This triangle may be solved by letting fall a perpendicular from the angle C on the side A B, which will divide it into two right-angled triangles; then with the hypothenuse A C and angle A find the perpendicular and the base, which base subtracted from the side A B, will leave the base of the other triangle; then, with the perpendicular and base find the angle B, which added to angle A, and their sum subtracted from 180°, will give the angle C, and with one of the angles and its opposite side find the side B C.

BY GUNTER'S SCALE.

1st. Extend the compasses from the sum of the two sides 132 to their difference 38; that extent will reach from 45° to a division[*] (16° 4′) on the line of tangents; then, the extent from this division to half the sum of the unknown angles 63° 40′, will reach from 45° to half their difference 30° 11′ on the line of tangents, by which the angles may be found as above.

2d. Extend from angle B 33° 29′ to angle A 52° 40′ on the line of sines; that extent will reach from the side A C 47 to the side B C 67. 7 on the line of numbers

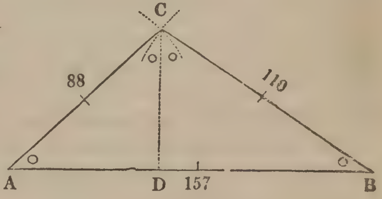
CASE IV.

The three Sides given, to find the Angles.

EXAMPLE. Given the side A B 157, the side B C 110, and the side A C 88, to find the angles A, B, and C.

BY CONSTRUCTION.

Draw the line A B, which make equal to 157; take the length of A C 88 in the compasses, and with one foot on A describe the arch C; then, with the length of C B 110 in the compasses, and one foot in B, describe an arch cutting the former in C, to which draw the lines A C and B C; then A B C is the triangle required; the angle A will measure 42° 44′, the angle B 32° 53′, and the angle C 104° 23′ (Prob. XIII. Geom.)



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[*] The necessity of noting this division arises from the line of tangents being read off from right to left above 45°, instead of being reckoned on towards the right; hence, in this case the point of the compasses falling without the Rule, the distance between this division and 63° 40′ gives the extent above 45°, which being applied to 45° backwards, falls upon the same division it would if the line were continued to the right.

BY CALCULATION.

To find the Segments AD, DB, *by Rule III.*

Side AC	88
Side BC	110
Sum	198
Difference	22

As the base or greatest side AB,	157	2.19590
Is to the sum of the sides AC, BC,	198	2.29666
So is the diff. of the sides AC, BC,	22	1.34242
		3.63908
		2.19590
To the diff. of the segments AD, DB	27.74	1.44318
Half the diff. of the segments	13.87	
Half their sum, or of the base AB	78.5	
Sum gives the greater segment DB	92.37	
Dift. gives the less segment AD	64.63	

To find the Angles by Rule I.

As the side AC 88	1.94448	As the side BC 110	2.04139
Is to radius, or sine 90°	10.00000	Is to radius, or sine 90°	10.00000
So is the segment AD 64.63	1.81043	So is the segment DB 92.37	1.96553
	11.81043		11.96553
	1.94448		2.04139
To sine of ang. ACD 47° 16′	9.86595	To sine of ang. BCD 57° 7′	9.92414
90 00		90 00	
Angle CAD 42 44		Ang. CBD 32 53	

Ang. ACD 47° 16′
Ang. BCD 57 7
Sum gives Angle ACB 104 23

BY GUNTER'S SCALE.

1st. Extend the compasses from the base 157 to the sum of the two sides 198 on the line of numbers; that extent will reach from the difference of the sides 22, to the difference of the segments 27.7; hence the segments will be found as above.

2d. Extend the compasses from the side AC 88, to the lesser segment AD 64.6 on the line of numbers; that extent will reach from 90° to the angle ACD 47° 16′ on the line of sines; hence the angle CAD is 42° 44′.

3d. Extend the compasses from the side CB 110 to the greater segment 92 4; that extent will reach from 90° to the angle DCB 57° 7′ on the line of sines; hence the angle CBD is 32° 53′

EXAMPLES FOR EXERCISE.

1. Given one side 129, an adjacent angle 56° 30′, and the opposite angle 81° 36′: required the third angle and the remaining sides.

Answer. The third angle is 41° 54′, and the remaining sides are 108. 7 and 87. 08.

2. Given one side 96. 5, another side 59. 7, and the angle opposite the latter side 31° 30′: required the remaining angles and the third side.

Answer. This question is ambiguous, the given side opposite the given angle being less than the other given side (see Rule I.); hence, if the angle opposite the side 96. 5 be acute, it will be 57° 38′, the remaining angle 90° 52′, and the third side 114. 2; but if the angle opposite the side 96. 5 be obtuse, it will be 122° 22′, the remaining angle 26° 8′, and the third side 50. 32.

3. Given one side 110, another side 102, and the contained angle 113° 36′: required the remaining angles and the third side.

Answer. The remaining angles are 34° 37′ and 31° 47′, and the third side is 177. 5.

4. Given the three sides respectively, 120. 6, 125. 5, and 146. 7: required the angles.

Answer. The angles are 51° 53′, 54° 58′, and 73° 9′.

5. Given one side 684. 5, another side 496. 7, and the angle opposite the latter side 40° 58′: required the remaining angles and the third side.

Answer. If the angle opposite the former side be acute, the remaining angles will be 64° 37′ and 74° 25′, and the third side 729. 8; but if obtuse, the angles will be 115° 23′ and 23° 39′ and the third side 303. 9.

6. Given one side 117. 8, another side 96. 55, and the contained angle 67° 30′: required the remaining angles and the third side.

Answer. The remaining angles are 64° 41′ and 47° 49′, and the third side 120. 4.

7. Given the three sides 87. 6, 66. 2, and 41. 3: required the angles.

Answer. The angles are 26° 49′, 46° 20′, and 106° 51′.

8. Given one side 80, an adjacent angle 40°, and the sum of the other sides 130: required the remaining angles and the other sides.

Answer. The remaining angles are 66° 22′, and 73° 38′, and the sides 53. 6 and 76. 4.

9. Given one side 564, its opposite angle 56° 30′, and the sum of the other sides 1046 (one of the adjacent angles being obtuse): required the remaining angles and the other sides.

Answer. The remaining angles are 90° 22′ and 33° 8′, and the sides 676. 3 and 369. 7.

10. Given one side 36. 5, the opposite angle 15° 30′, and the difference of the other sides 18: required the remaining angles and the other sides.

Answer. The remaining angles are 111° 30′ and 53° 0′, and the sides 127. 1 and 109. 1.

GEOGRAPHY.

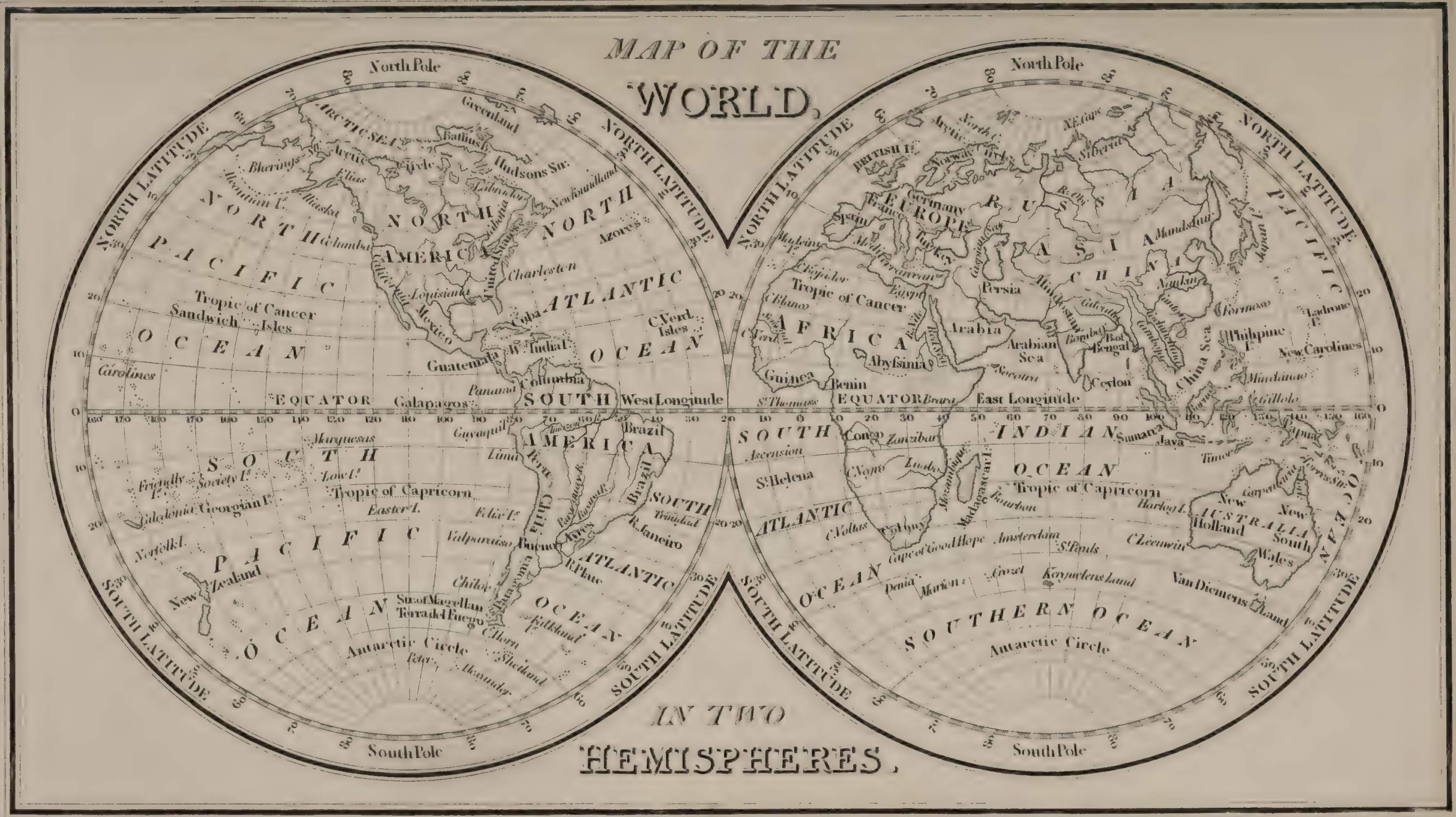
GEOGRAPHY is a description of the figure, magnitude, and positions of the several parts of the surface of the earth.

OF THE FIGURE AND MAGNITUDE OF THE EARTH.

Various opinions were entertained by the ancients respecting the figure of the earth. Some imagined it an immense plane surrounded by an impassable ocean; others, that it was cylindrical; and some that it was a sphere or globe: which last opinion is now ascertained to be nearly the truth. The most obvious of the several arguments which prove the sphericity of the earth, and what must particularly strike every mariner, are, that when approaching the shores of countries, the points of high rocks, lighthouses, steeples of churches, and other thin but lofty objects, come into view much sooner than houses or other buildings of greater magnitude, but less height; in like manner, when ships are approaching each other at sea, the masts and rigging are discerned some time before the hull and lower parts of the vessel, though much larger, come to view. Again, seamen, it is well known, frequently discover distant lands from the tops of a ship's masts, long before they are visible to those who stand upon deck. These circumstances prove that the surface of the earth is convex; and as the same appearances happen wherever the observer is situated, this convexity must be uniform: hence we conclude that the earth is globular. The sphericity of the earth is likewise demonstrated by navigators who have sailed quite round it, by constantly going westward, and arriving home from the eastward, which could not be effected were the earth a plane: thus Ferdinand Magellan, setting out on the west side of Spain, continued shaping his course westward till he returned home on the south-eastern side of Spain; and thus also have Drake, Dampier, Cook, and others, circumnavigated the earth; and when, in addition to these facts, it is recollected that all the rules of Navigation are conformable to the opinion of the earth being nearly globular, and that these rules never lead the mariner into material error, these well-known circumstances, without adducing others (though others equally or more forcible might be adduced), must sufficiently establish the belief, in the mind of every impartial and competent judge, that the earth deviates but very little in its form from that of a sphere.

Supposing the earth to be in the exact form of a sphere, any section of it made by a plane passing through its centre would be a circle, the circumference of which being conceived to be divided into 360 equal parts, called degrees, and the length of one of these measured, the whole circumference, and thence the diameter, of the earth, may be easily determined. For this purpose several mathematicians have undertaken the measurement of a degree on a meridian; and from the mean result of their several admeasurements, we may conclude that the circumference of the earth is

MAP OF THE WORLD, IN TWO HEMISPHERES,



nearly 24869, and its mean diameter 7916, English miles; also that one degree contains about 69. 08 English miles, and that a nautical or geographical mile is equal to 6079 feet.

On comparison of the several admeasurements of a degree on a meridian, it was found they varied in different parts of the earth. This circumstance, together with others arising from the principle of gravity, led to the belief that its figure was not that of an exact sphere; and, in fact, it has been proved that the earth is flatted at the poles, similar to the figure of an orange, or rather that its form is that of an oblate spheroid, which is a solid, generated by the rotation of a semi-ellipsis about its shorter axis. It has likewise been established, that its polar and equatorial diameters are respectively 7898 and 7924 English miles, being nearly in the ratio of 304 to 305; but since its figure differs so little from that of a perfect sphere, it is usual, for the ease of calculation, to consider it of that form, which approaches sufficiently near the truth for almost all practical purposes, either in Navigation or Astronomy

OF THE NATURAL DIVISIONS OF THF EARTH.

The constituent parts of the earth are land and water: these naturally divide its surface into various portions, which have received the following particular terms, according to their size, shape, and situation.

A Continent is a large tract of land comprehending several empires, kingdoms, or countries, not separated by any sea or ocean, as the Continents of Europe, Asia, Africa, and America.

An Island is a portion of land entirely surrounded by water, as Great Britain and Ireland.

A Peninsula is a part of land nearly encompassed with water, except where it is joined to a continent by a narrow neck or point of land; as the Morea in the Mediterranean Sea.

An Isthmus is the narrow neck of land joining a peninsula to the adjacent land, and forms a communication between them; as the Isthmus of Darien, which joins North and South America.

A Promontory is a high part of land that projects into the sea, and is often called a Cape when the land is high; and when it has but little elevation, it is more usually distinguished by the name of a Point or Head Thus the Cape of Good Hope is a mountainous promontory; and the Lizard, at the entrance to the English Channel, a point or headland.

An Ocean is a vast collection of water, separating continents from each other, as the Atlantic and Pacific Oceans.

A Sea is a smaller collection of water, communicating with some adjacent ocean, and confined by land within a narrower space; as the Mediterranean and Baltic Seas. This term is sometimes used in a general sense for the whole body of salt water on the terraqueous globe.

A Gulf is a part of the sea or ocean nearly surrounded by land, except where it immediately communicates with the sea; as the Gulf of Venice, in the Mediterranean; the Gulfs of Finland and Bothnia, in the Baltic Sea.

A Bay is such a gulf or inlet as does not run very deep into the land; as the Bay of Biscay, between the shores of France and Spain, and the Bay of Bengal, in the East Indies. Bays of a smaller description are frequently denominated Creeks, Havens, or Roads, though the last term is usually applied to places upon any coast where there is anchorage, and a certain degree of protection and shelter from winds.

A Strait is a narrow passage by which there is a communication between a gulf and the adjacent sea, or which joins one part of a sea or ocean with another; as the Strait of Gibraltar, which joins the Mediterranean Sea to the Atlantic Ocean.

A Lake is a collection of water in an inland part, and, strictly considered, has no communication with the sea; as the Lake of Geneva. But this is not always attended to, for many of the loughs, or lakes, in Ireland and Scotland, and those in North America, as Lake Superior, Ontario, &c. are an exception.

OF THE IMAGINARY DIVISIONS OF THE EARTH.

In order to point out the exact relative situation of places on the surface of the terraqueous globe, geographers are obliged to imagine certain points, lines, and circles belonging thereto, of which such as will more immediately enter under our consideration, we shall here explain.

The Axis is an imaginary line passing through the centre of the earth. The extremities of this line are called the Poles: that which is nearest to us is called the *North Pole*, and its opposite the *South Pole*. The earth revolves round the axis, from west to east, in 24 hours, which causes the vicissitude of day and night.

The Equator is a great circle on the earth equally distant from the Poles. It divides the earth into two equal parts, called Hemispheres; that having the North Pole in its centre, is called the *Northern Hemisphere;* and the other the *Southern Hemisphere.*

Meridians are imaginary circles on the earth passing through both the Poles, crossing the equator at right angles, and dividing the globe into two parts, called the *Eastern* and *Western Hemispheres;* or rather, the meridian of a place is a semicircle passing through the place, and terminating at the Poles, the remaining half being called the *opposite Meridian;* hence every north and south line is part of a meridian.

It is usual for geographers to fix upon a meridian passing through some remarkable place, and to call it the *first Meridian:* thus, the British esteem that the first meridian which passes through the Royal Observatory at Greenwich; so the French reckon, for their first meridian, that which passes through the Royal Observatory at Paris; the Spaniards that which passes through Cadiz, and some geographers the meridian of Teneriffe. Hence it appears the fixing of a first meridian is entirely arbitrary, most nations considering that the first meridian which passes through their capital, or principal observatory.

The HORIZON is that apparent circle which limits or bounds the view of a spectator on the sea, or on an extended plane, the eye being always supposed in the centre of the horizon. This circle is divided into 32 parts, called points, for a description of which see Mariner's Compass.

The earth is sometimes divided by certain circles, parallel to the equator, into portions, called ZONES; these are distinguished into two frigid, two temperate, and one torrid, in allusion to the general state of the air, with respect to heat and cold, which prevails in each of the situations.

The FRIGID ZONES are those regions about the Poles where the sun at certain times of the year does not rise or set for some days; they extend round the Poles as far as 23° 28′: the imaginary circle which bounds this limit in our northern hemisphere is called the *Arctic Polar Circle*, and that portion of the globe included within it, the *North Frigid Zone.* The circle which is at the same distance from the South Pole, in the southern hemisphere, is called the *Antarctic Polar Circle,* and the space between it and the Pole is termed the *South Frigid Zone.*

The TEMPERATE ZONES are those portions of the earth comprehended between the Polar Circles, and two parallel circles that are 23° 28′ distant from the equator: of these parallels, that in the northern hemisphere is called the *Tropic of Cancer;* and the other, in the southern hemisphere, the *Tropic of Capricorn.*

The TORRID ZONE is the space included between the two tropics, over every part of which the sun is vertical at some time of the year.

Besides these divisions into zones, the ancients divided the earth into CLIMATES, which are spaces contained between two parallels, where the difference in the longest day in each parallel is half an hour, as far as the Polar circles; and beyond that, where they differ by a month. They likewise distinguished the inhabitants by different names, according to the diversity of shadows of upright bodies at noon, and their relative situation with regard to each other; but these vague expressions, intended to give some general idea of the situation of different countries, have at length given way to the more precise terms of latitude and longitude.

OF LATITUDE AND LONGITUDE.

The LATITUDE of a place is its distance from the equator, measured by an arch of a meridian contained between the equator and the given place it is called either north or south, according as the given place is situated in the northern or southern hemisphere. Latitude is therefore reckoned from the equator towards the Poles, and never exceeds 90 degrees, that being the distance of the Poles from the equator. Hence a ship in north latitude sailing northerly, or in south latitude sailing southerly, increases her latitude; but in north latitude sailing southerly, or in south latitude sailing northerly, she decreases her latitude.

The Parallel of Latitude of any place is a circle passing through that place parallel to the equator.

The Difference of Latitude between any two places is an arch of a meridian, contained between the parallels of latitude of those places.

The Longitude of a place is an arch of the equator comprehended between the first meridian and that meridian which passes through the given place. It is usual to reckon longitude from the first meridian, either east or west, according as the given place lies in the eastern or western hemispheres, until it meet at the opposite meridian: therefore the longitude of a place cannot exceed 180 degrees, or a semicircle. A ship in east longitude sailing easterly, or in west longitude sailing westerly, increases her longitude; but in east longitude sailing westerly, or in west longitude sailing easterly, she decreases her longitude.

The Difference of Longitude between two places is an arch of the equator intercepted between the meridians of those places, and cannot exceed 180 degrees.

PROBLEM I.

To find the difference of Latitude between two Places.

Rule. When the latitudes are both of the same name, that is, both north or both south, subtract the less from the greater, and the remainder will be the difference of latitude; but when one is north, and the other south, their sum will be the difference of latitude.

Example I. What is the difference of latitude between the Lizard and Cape Finisterre?

Latitude of the Lizard ...	49°	58′ N.
Lat. of Cape Finisterre...	42	56 N.
Diff. of latitude	7	2
	60	
In miles	422	

Example II. A ship from latitude 3° 10′ S. arrives to latitude 2° 26′ N.: required the difference of latitude made good.

Latitude left..................	3°	10′ S.
Latitude in	2	26 N
Diff. of latitude	5	36
	60	
In miles...............	336	

PROBLEM II.

With the Latitude left, and the difference of Latitude, to find the Latitude in.

Rule. When the latitude left, and difference of latitude, are of the same name, their sum gives the latitude in; but when they are of contrary names, their difference is the latitude in, of the same name with the greater.

Example I. A ship from the West end of the Island of Madeira, in latitude 32° 49′ N., sails North 520 miles*: what latitude is she in?

Latitude of Madeira	32°	49′	N.
Diff. of latitude 520 or ...	8	40	N.
Latitude in...........	41	29	N.

Example II. A ship three days ago was in latitude 2° 48′ N., and has since then sailed South 426 miles required her present latitude.

Latitude left	2°	48	N
Diff. of latitude 426 or...	7	6	S.
Latitude in...........	4	18	S.

PROBLEM III.

To find the Difference of Longitude between two Places.

Rule. If the longitudes of the given places be both east or both west, subtract the less from the greater; but if one be east, and the other west, add them together, and the sum or remainder will be the difference of longitude. When the sum of the two longitudes exceed 180 degrees, subtract it from 360 degrees, and the remainder will be the difference of longitude.

Example I. What is the difference of longitude between the Lizard and St. Mary's, one of the Western Islands?

Longitude of the Lizard	5°	11′	W.
Longitude of St. Mary's	25	13	W.
Diff. of longitude...	20	2	
	60		
In miles	1202		

Example II. A ship sailing Westward from North Cape, New Zealand, arrives at longitude 164° 47′ W.: required the diff. of longitude made good.

Long. of North Cape ...	173°	10′	E.
Long. of ship	164	47	W.
Sum	337	57	
	360	0	
Diff. of longitude...	22	3	
	60		
In miles	1323		

PROBLEM IV.

With the Longitude left, and Difference of Longitude, to find the Longitude in.

Rule. If the longitude left, and difference of longitude, be of contrary names, subtract the less from the greater, and the remainder will be the longitude in, of the same name with the greater; but if the longitude left, and difference of longitude, be of the same name, their sum will be the longitude in, of the same name with the longitude left: if this sum exceed 180°, subtract it from 360°, and the remainder will be the longitude in, of a contrary name to the longitude left.

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* When the difference of latitude or longitude is given in miles, it is to be divided by 60, to reduce it to degrees and minutes.

Example I. Suppose a ship from St. Helena sail eastward till her difference of longitude be 220 miles: required her longitude in.

Long. of St. Helena	5°	45′ W.
Diff. of longitude 220 or...	3	40 E.
Longitude in	2	5 W.

Example II. If a ship from longitude 176° 49′ W. sail westward till her difference of longitude be 10° 14′ W., what is her present longitude?

Longitude left	176°	49′ W
Diff. of longitude	10	14 W.
Sum	187	3
	360	0
Longitude in......	172	57 E

EXAMPLES FOR EXERCISE.

1. Required the difference of latitude and longitude between Ushant Island and Cape Ortegal.
Answer. Diff. of latitude 281 miles; diff. of longitude 168 miles.

2. What is the difference of latitude and longitude between the Cape of Good Hope and Cape Horn.
Answer. Diff. of latitude 1297 miles; diff. of longitude 5136 miles.

3. Required the difference of latitude and longitude between Cape Verde (paps) and Cape St. Roque.
Answer. Diff. of latitude 1211 miles; diff. of longitude 1066 miles.

4. Required the difference of latitude and longitude between Port Jackson, in New South Wales, and Karakakoa Bay in Owhyhee or Hawaii, one of the Sandwich Islands.
Answer. Diff. of latitude 3199 miles; diff. of longitude 3160 miles.

5. A ship from Funchal, in Madeira, sails in the S. E. quarter until her difference of latitude is 326 miles, and difference of longitude 425 miles: required her present latitude and longitude.
Answer. Latitude 27° 12′ N.; longitude 9° 51′ W.

6. A ship from latitude 2° 56′ S., and longitude 5° 14′ E., sails north-westerly till her difference of latitude is 352 miles, and difference of longitude 628 miles. required her present latitude and longitude.
Answer. Latitude 2° 56′ N.; longitude 5° 14′ W.

7. A ship from the Equator, and longitude 89° 17′ E., sails south-westerly till her difference of latitude is 370 miles, and difference of longitude 118 miles: required her present latitude and longitude.
Answer. Latitude 6° 10′ S.; longitude 87° 19′ E.

8. A ship from Cape East, in New Zealand, sails in the N. E. quarter till her difference of latitude is 114 miles, and difference of longitude 297 miles: required her present latitude and longitude.
Answer. Latitude 35° 51′ S., and longitude 176° 27′ W.

Note. The latitudes and longitudes of the given places are to be taken from Table LVI.

Description and Use of the
LOG, HALF-MINUTE GLASS, AND COMPASS.

THE instruments used for estimating a ship's path or track at sea, are the log, half-minute glass, and compass.

OF THE LOG AND HALF-MINUTE GLASS.

The common Log is a flat piece of wood in the form of a quadrant, with a sufficient quantity of lead fixed to the circular edge to keep it steady, and in a perpendicular position on the surface of the water. To this is fastened a line about 120 fathoms long, called the Log Line, which is divided into spaces called Knots, and wound on a reel, from which it runs off freely when used.*

The Half-minute Glass is of the same shape with an hour-glass, and contains such a quantity of sand as will run through the hole in its neck in half-a-minute of time.

The use of these instruments is to ascertain the velocity of a ship, or at what rate she sails, by an operation called *heaving the log*, which is performed in the following manner:—The reel being held by one man, and the half-minute glass by another, the officer of the watch throws the log over the ship's quarter on the lee side, which swimming perpendicularly, remains stationary; and when he observes the first mark is going over the ship's side, which is usually a red rag at the distance of 10 or 12 fathoms from the log (that quantity, called *stray line*, being allowed, in order to carry the log out of the eddy of the ship's wake), he gives notice to the man who holds the glass, to turn it; and as soon as the sand in the glass is run out, the line is immediately stopped; then, the number of knots and fathoms which had run off at the expiration of the glass, being considered as miles and parts, gives the distance the ship has run the preceding hour, if the wind has been constant: but if the gale has not been the same during the whole hour, or time between heaving the log, or if there has been more

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[*] Several machines have been invented for measuring the distance run by a ship in a given time; but the best of these is *Massey's Patent Log*. This machine consists of two parts, the *Register*, containing a system of wheel-work connected with the fingers of three several indexes; and the *Rotator*, which is a hollow cylinder, made air-tight, with four vanes placed on it obliquely, and fastened by a cord, about six feet in length, to one end of the register. To a loop-hole at the other end of the register is secured another line, of sufficient length (30 to 50 fathoms) to keep the machine beyond the eddy of the ship's wake, which line is made fast to the vessel.

When the log is used, all the fingers of the indexes are set at 0, and both register and rotator committed to the water; as the vessel moves forward the log follows, and from the obliquity of the vanes, it is evident the rotator must revolve quicker or slower, correspondent to the ship's velocity. This rotatory motion is communicated by the cord to the wheel-work connected with the fingers of the indexes, by which means the actual space passed through in any given time is pointed out. This log has been in use several years, particularly in the Royal Navy.

sail set or handed, there must be an allowance made for it, according to the discretion of the officer. Sometimes, when the ship is before the wind, and a great sea setting after her, it will bring home the log; in such cases it is customary to allow one mile in ten, and less in proportion if the sea be not so great; a proper allowance ought also to be made if there be a head sea. In heaving the log, great care should be taken to veer out the line as fast as the log takes it; for if the log be left to turn the reel itself, it will come home, and give an erroneous distance.

When the ship is sailing several knots an hour, sometimes quarter-minute glasses are used, in which case the knots and fathoms run off the reel are to be doubled, to give the hourly rate.

In ships of war and East Indiamen, it is usual to heave the log once every hour; but in merchant ships only once every two hours.

The length of the log-line between each knot ought to be 51 feet nearly, that being the same part of a nautical mile that half-a-minute is of an hour*, *viz.* 120th part; but as the log is apt to be drawn after the vessel, and as it is safer to have the reckoning rather before than after the ship, 50 feet have been thought sufficient space between the knots, each of which contains 10 fathoms of 5 feet. Indeed it is usual to allow only 48 feet to a knot, that is, 8 fathoms of 6 feet each, and sometimes a less quantity, with which a glass is used running 28 seconds; but whatever may be the assigned length of the intervals between the knots, it is most convenient to divide them decimally, or into ten equal parts, by which the computation of the ship's run will be rendered more easy and accurate.

But both the log-line and half-minute glass are frequently affected by alterations in the heat or moisture of the weather; it therefore becomes necessary often to examine them, and if found erroneous, to correct the ship's run. The length of line between the knots may be easily ascertained by measuring them with a rule: and the half-minute glass may be examined either by a watch with seconds, or if that be not at hand, by the following method—fasten a plummet to a line, and hang it on a nail, observing that the distance between the nail and the middle of the plummet be 39¼ inches; then swing the plummet, and notice how often it passes under the nail while the glass is running out, and that will be the number of seconds measured by the glass.

The following rules for correcting the ship's run, on account of the errors in the log-line or half-minute glass, are given on a supposition that the knot ought to measure 50 feet, and the glass to run 30 seconds.

CASE I.

When the Log-line is truly divided, and the Glass faulty.

Rule. Multiply the distance given by the log by 30; divide the porduct by the seconds run by the glass, and the quotient will be the true distance.

---

* The length of a nautical mile is about 6079 English feet (see page 53): this divided by 120, gives 50 feet 8 inches for the length of a knot.

Example I. If a ship sail 8 knots by the log, while the glass is running out, which when measured, is found to sun 34 seconds, what is her true rate of sailing?

Distance by log 8 knots.
30

34) 240 (7 knots.
238

2

Example II. Suppose the distance sailed by the log be 75 miles, and the glass run out in 27 seconds, what is the true distance run?

Distance by log 75 miles.
30

27) 2250 (83. 3 true distance sailed.
216

90
81

90
81

9, &c.

CASE II.

When the Glass is true, and the Log-line faulty.

Rule. Multiply the distance sailed by twice the measured length of a knot; then point off two figures to the right, and the remainder will be the true distance.

Example I. A ship sails 9 knots in half-a-minute, by a log measuring 52 feet; required her true rate of sailing.

Distance by log............	9 knots.
Twice the length of a knot	104
True rate	9. 36 knots,

or 9 knots 4 fathoms nearly.

Example II. If a ship sail 195 miles by a log which measures 48 feet, what is her true distance run?

Distance by log	195 miles.
Twice the length of a knot	96
	1170
	1755
True distance............	187. 20 miles.

CASE III.

When the Glass and Log-line are both faulty.

Rule. Multiply the distance sailed by the log, by six times the measured length of a knot, and divide the product by the seconds run by the glass; the quotient, pointing off one figure to the right, will be the true distance.

Example I. If a ship run 5 knots of a log-line of 45 feet to a knot, while a glass of 25 seconds is running out, what is her true rate of sailing?

Distance run by log 5
6 times the length of a knot 45×6=270
Seconds run by a glass ...25) 135. 0
True rate of sailing 5. 4
or 5 knots 4 fathoms.

Example II. Suppose the distance sailed by the log be 150 miles, the measured length of a knot being 51 feet, and the glass running 28 seconds: required the true distance run.

Distance by log .... 150 miles
6 times length of a knot 306
28) 4590. 0
True distance run ...... 163. 9 miles.

To find the Length of a Knot corresponding to a Glass running any given Number of Seconds

Rule. Add a cipher to the number of seconds run by the glass, and divide this by 6; the quotient will be the proportional length of a knot in feet.

Example I. What ought to be the length of a knot when the glass runs 33 seconds?

6)330
55 feet.

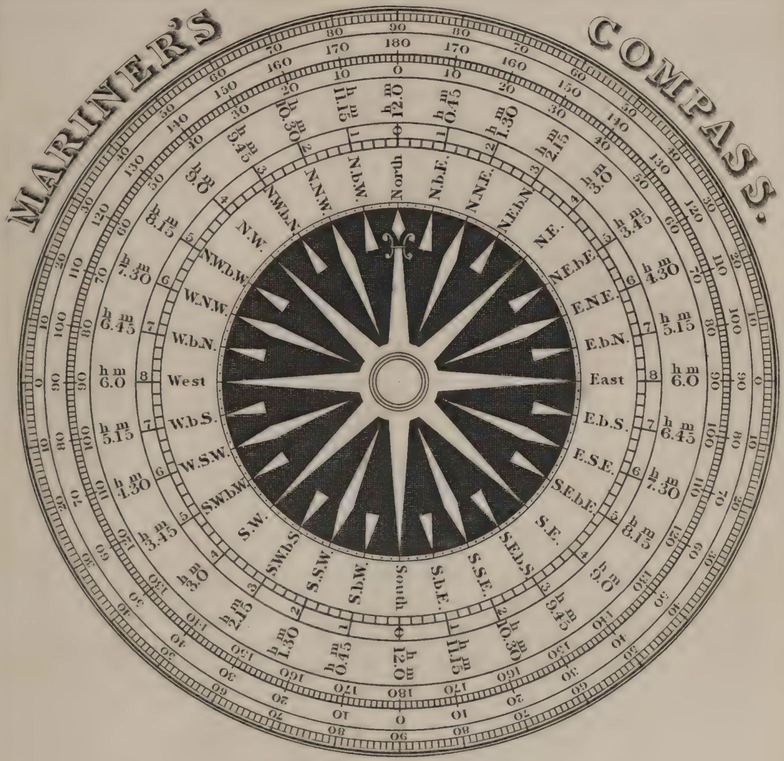
Example II. Required the length of a knot corresponding to a glass that runs 28 seconds.

6)280
46. 67 or 46 feet 8 in

OF THE MARINER'S COMPASS.

This instrument is an artificial representation of the horizon of any place. It consists of a circular card, divided into 32 equal parts, by lines drawn from the centre to the circumference, called Rhumb Lines, the extremities of which are termed Points or Rhumbs: the intervals are subdivided into halves and quarters, called Half Points and Quarter Points; the whole circumference is likewise divided into 360 degrees, consequently the angle comprehended between any two rhumbs is equal to 11 degrees 15 minutes. The four principal points are called the Cardinal Points, two of which, opposite each other, are called the North and South Points: that which is on the right hand, when we look towards the north, is termed the East, and its opposite the West Point; the names of the other points are compounded of these, according to their situation, but instead of the words, the initials only are inserted, as exhibited in Plate III., where there is also a Table, containing the measure of the angles that each point, and quarter point, makes with the north and south, or meridian line. Under the card, along the north and south line, a small bar of steel is fixed, called the Needle, which being magnetized, or touched with a loadstone acquires

MARINER'S COMPASS.



A TABLE OF THE ANGLES

which every Point & Quarter Point of the Compass makes with the Meridian.

NORTH		POINTS	° ′ ″	POINTS	SOUTH	
		0 – ¼	2 . 48 . 45	0 – ¼		
		0 – ½	5 . 37 . 30	0 – ½		
		0 – ¾	8 . 26 . 15	0 – ¾		
N.b.E.	N.b.W.	1	11 . 15 . 0	1	S.b.E.	S.b.W.
		1 – ¼	14 . 3 . 45	1 – ¼		
		1 – ½	16 . 52 . 30	1 – ½		
		1 – ¾	19 . 41 . 15	1 – ¾		
N.N.E.	N.N.W.	2	22 . 30 . 0	2	S.S.E.	S.S.W.
		2 – ¼	25 . 18 . 45	2 – ¼		
		2 – ½	28 . 7 . 30	2 – ½		
		2 – ¾	30 . 56 . 15	2 – ¾		
N.E.b.N.	N.W.b.N.	3	33 . 45 . 0	3	S.E.b.S.	S.W.b.S.
		3 – ¼	36 . 33 . 45	3 – ¼		
		3 – ½	39 . 22 . 30	3 – ½		
		3 – ¾	42 . 11 . 15	3 – ¾		
N.E.	N.W.	4	45 . 0 . 0	4	S.E.	S.W.
		4 – ¼	47 . 48 . 45	4 – ¼		
		4 – ½	50 . 37 . 30	4 – ½		
		4 – ¾	53 . 26 . 15	4 – ¾		
N.E.b.E.	N.W.b.W.	5	56 . 15 . 0	5	S.E.b.E.	S.W.b.W.
		5 – ¼	59 . 3 . 45	5 – ¼		
		5 – ½	61 . 52 . 30	5 – ½		
		5 – ¾	64 . 41 . 15	5 – ¾		
E.N.E.	W.N.W.	6	67 . 30 . 0	6	E.S.E.	W.S.W.
		6 – ¼	70 . 18 . 45	6 – ¼		
		6 – ½	73 . 7 . 30	6 – ½		
		6 – ¾	75 . 56 . 15	6 – ¾		
E.b.N.	W.b.N.	7	78 . 45 . 0	7	E.b.S.	W.b.S.
		7 – ¼	81 . 33 . 45	7 – ¼		
		7 – ½	84 . 22 . 30	7 – ½		
		7 – ¾	87 . 11 . 15	7 – ¾		
East.	West.	8	90 . 0 . 0	8	East.	West.

I.W.Norie delint. J. Dewer Sculp.

the peculiar property of pointing north and south*, and consequently by the card determines the direction of the other points of the horizon. The needle, having a small socket in the centre, is supported, together with the card, on the point of a fine steel pin, on which it freely turns, and by the above-mentioned property its points keep always in the same direction: these are confined in a circular brass box with a glass cover, the box being hung in brass hoops or gimbals, in order to counteract the motion of the ship. The whole of these are placed in a square wooden box with a moveable lid, which serves to support the gimbals, and secure the compass from accident in removals.

The compass is used to point out the direction that a ship sails at sea. For this purpose, it is to be so placed in the ship that the middle section of the wooden box, parallel to its sides, may be parallel to the middle section of the ship along its keel. When it is thus fixed, that point of the card which coincides with a perpendicular line, marked in the inside of the circular box, and termed by seamen LUBBER'S POINT, will shew the direction of the ship's head.

The courses and distances which a ship sails in 24 hours are usually set down on a board, called the LOG BOARD, which will be further explained hereafter.

PLANE SAILING

PLANE SAILING is the art of navigating a ship upon principles deduced from the supposition of the earth being an extended plane. On this supposition, the meridians are considered as being all parallel to each other, the parallels of latitude at right angles to the meridians, and the length of a degree on the meridian, equator, and parallels of latitude, every where equal. In this sailing there are four principal parts, *viz.* the Course, Distance, Difference of Latitude, and Departure.

The COURSE is the angle which a ship's track or path makes with the meridian, and is expressed either in points or degrees. Thus, when a ship sails in a north-east direction, we say her course is 4 points, or 45 degrees.

The DISTANCE is the number of miles, &c. between any two places reckoned on the rhumb line of the course; or it is the length that a ship has sailed on a direct course in a given time.

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* This is not strictly true, for the needle deviates more or less from the north and south points of the horizon, at different places, and at different times; but as the methods by which this deviation of the needle is found, depend on astronomical observations, we shall defer entering into a further explanation till we treat on that subject.

The DIFFERENCE OF LATITUDE is the distance which a ship has made north or south of the place sailed from, and is reckoned on a meridian.

The DEPARTURE is the east or west distance a ship has made from the meridian of the place she departed from, and is reckoned on a parallel of latitude.

Hence it is evident that if a ship sail due north or south, she sails on a meridian, makes no departure, and her distance and difference of latitude are the same. If a ship sail due east or west, she runs on a parallel of latitude, makes no difference of latitude, and her departure and distance are the same; but when a ship sails in any other direction, she makes both difference of latitude and departure, and these, with the distance, form a right-angled triangle, the hypothenuse of which is the distance sailed, the perpendicular is the difference of latitude, the base the departure, the angle opposite the base is the course, and that opposite the perpendicular the complement of the course: hence, any two of these parts being given, the rest may be found by Plane Trigonometry.

When a ship's course is 4 points, or 45 degrees, the difference of latitude and departure are equal; when the course is less than 4 points, or 45 degrees, the difference of latitude is greater than the departure; when the course is more than 4 points, or 45 degrees, the departure is greater than the difference of latitude.

In constructing a figure relating to a ship's course, let the upper part of what the figure is drawn on represent the north, then the lower part will be the south, the right hand east, and the left west.

Draw a north and south line, to represent the meridian of the place the ship sailed from; then if the ship's course be to the southward, mark the upper end of the line for the place sailed from; but if the course be northward, mark the lower end for that place.

Through the point sailed from draw a line, making a right angle with the meridian line (Prob. XII. Geom.) on the east or west side, according as the ship is sailing to the eastward or westward; and that line will represent the parallel of the place the ship sailed from.

When the course is given, it is to be laid off from the meridian on the arch described in making the right angle, taken either from the line of chords or rhumbs, according as it is given in degrees or points.

A line drawn from the centre of the quadrant, through the point laid off for the course, will represent the distance, which, if given, is to be laid thereon, beginning at the point sailed from. A line drawn from the extremity of the distance, parallel to the east or west line, will determine the difference of latitude and departure.

If the difference of latitude be given, it is to be laid upon the meridian, beginning at the point representing the place the ship left; and a line drawn from the extremity of the difference of latitude, parallel to the east or west line, till it meet the distance produced, will form the figure.

If the departure be given, it is to be drawn parallel to the east or west line, through the extremity of the difference of latitude or distance.

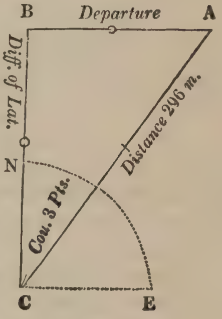
CASE I

The Course and Distance given, to find the Difference of Latitude and Departure.

Example. A ship from latitude 48° 40′ N., sails N. E. by N. 296 miles required her present latitude, and the departure made good.

BY CONSTRUCTION.

Draw the line B C to represent the meridian the ship sailed from; with the chord of 60° in the compasses, and one foot in C, describe the arch N E; from N to E lay off the chord of 90°, and draw the line C E: then will N C E represent the N. E. quarter of the compass. Take the course three points in the compasses from the line of rhumbs, which lay off from N towards E, and through the point where it cuts the arch draw the line C A, which make equal to the distance 296, taken from a scale of equal parts; through A draw the line B A parallel to C E (Prob. IV. Geom.); then will B A represent the departure equal to 164. 4 miles, and C B the difference of latitude 246 miles.



BY CALCULATION.

To find the Departure.

As radius	10. 00000
Is to distance 296	2. 47129
So is sine of course 3 pts.[*]	9. 74474
	12. 21603
	10. 00000
To the departure 164. 4	2. 21603

To find the Difference of Latitude.

As radius	10. 00000
Is to distance 296	2. 47129
So is co. sine of course 3 pts.	9. 91985
	12. 39114
	10. 00000
To the diff. of latitude 246. 1	2. 39114

To find the Latitude in.

Latitude left	48° 40′ N.
Diff. of latitude 246 miles, or	4 6 N.
Latitude in	52 46 N.

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[*] The course being given in points, the logarithm of its sine, &c. is to be taken from Table XXIII.

BY INSPECTION.*

Enter the first Traverse Table, and find the course 3 points at the top, and in one of the columns marked *dist.* find the distance 296; then opposite to this, in the columns marked *lat.* and *dep.*, will be the difference of latitude 246. 1, and the departure 164. 4.

BY GUNTER'S SCALE.

Extend from radius, or 8 points, to the course 3 points on the line of sine rhumbs, marked S. R.; that extent will reach from the distance 296, to the departure 164. 4 on the line of numbers.

Extend from radius, or 8 points, to the complement of the course 5 points on the line of sine rhumbs; that extent will reach from the distance 296, to the difference of latitude 246. 1 on the line of numbers.

CASE II.

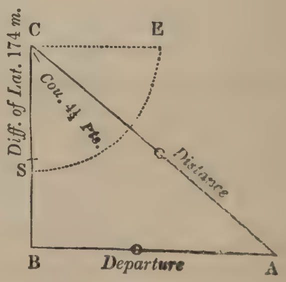
The Course and Difference of Latitude given, to find the Distance and Departure.

EXAMPLE. A ship sails S. E. ½ E. from St. Helena, in latitude 15°55′ S., until by observation she is in latitude 18° 49′ S.: required her distance run, and departure made good.

Latitude of St. Helena	15° 55′ S.
Latitude come to	18 49 S.
Difference of latitude...	2 54 = 174 miles.

BY CONSTRUCTION.

Draw the meridian line C B, which make equal to the difference of latitude 174; from C, with the chord of 60°, describe the arch S E, on which lay off 90°, and draw the line C E; from S towards E lay off the course 4½ points, taken from the line of rhumbs, and through the point where it cuts the arch S E draw the line C A; from B draw the line B A parallel to the line C E; then will the departure B A measure 212, and the distance C A 274. 3 miles.



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* Previous to resolving the Cases by this method, it will be necessary for the learner to read attentively the Explanation to Tables I. and II., which are constructed by this Case for every point, quarter-point, and degree of the compass, to distances not exceeding 300

BY CALCULATION.

To find the Departure.

As co. sine of course 4½ pts.	9. 80236
Is to diff. of latitude 174	2. 24055
So is sine of course 4½ pts.	9. 88818
	12. 12873
	9. 80236
To the departure 212	2. 32637

To find the Distance.

As co. sine of course 4½ pts.	9. 80236
Is to diff. of latitude 174	2. 24055
So is radius	10. 00000
	12. 24055
	9. 80236
To the distance 274. 3	2. 43819

BY INSPECTION.

Over the course 4½ points, find the difference of latitude 174 (or the nearest to it, which is 173. 8) in a *lat.* column, opposite to which will be found the departure 211. 8, and the distance 274, in their respective columns.

BY GUNTER'S SCALE.

Extend from the complement of the course 3½ points, to the course 4½ points on the line of sine rhumbs; that extent will reach from the difference of latitude 174 to the departure 212 on the line of numbers.

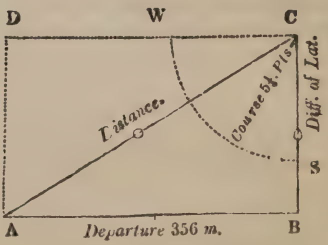
Extend from the complement of the course 3½ points, to radius, or 8 points, on the line of sine rhumbs; that extent will reach from the difference of latitude 174 to the distance 274. 3 on the line of numbers.

CASE III.

The Course and Departure given, to find the Difference of Latitude and Distance.

Example. A ship from latitude 3° 16′ N., sails S. W. by W. ¼ W., until she has made 356 miles of departure: required her present latitude, and distance sailed.

BY CONSTRUCTION.



Draw the meridian line C B, and describe the quadrant C W S to represent the S. W. quarter of the compass; from S towards W lay off the course 5¼ points, and through the point where it cuts the arch S W draw the line C A; from C to D lay off the departure 356, and through D draw the line D A parallel to C B, meeting the line C A in A; through A draw the line A B parallel to D C, meeting C B in B: then will the difference of latitude C B measure 213. 4, and the distance A C 415. 1

BY CALCULATION.

To find the Difference of Latitude.

As sine of course 5¼ pts.	9. 93335
Is to departure 356	2. 55145
So is co. sine of course 5¼ pts.	9. 71105
	12. 26250
	9. 93335
To the diff. of latitude 213. 4	2. 32915

To find the Distance.

As sine of course 5¼ pts.	9 93335
Is to departure 356	2. 55145
So is radius	10. 00000
	12. 55145
	9. 93335
To the distance 415. 1	2. 61810

To find the Latitude in.

Latitude left......................	3° 16′ N.
Diff. of latitude 213 miles, or	3 33 S.
Latitude in	0 17 S.

BY INSPECTION.

In that page of the Traverse Table marked with the course 5¼ points at the bottom, find half the given departure, *viz.* 178 (the whole being too great) in the *dep.* column; opposite to which, in the *lat.* and *dist.* columns, will be 106. 9 and 208; these being multiplied by 2, give the whole difference of latitude 213. 8, and the distance 416 miles.

BY GUNTER'S SCALE.

Extend from the course 5¼ points to the complement of the course 2¾ points on the line of sine rhumbs; that extent will reach from the departure 356 to the difference of latitude 213. 4 on the line of numbers.

Extend from the course 5¼ points to 8 points on the line of sine rhumbs; that extent will reach from the departure 356 to the distance 415. 1 on the line of numbers.

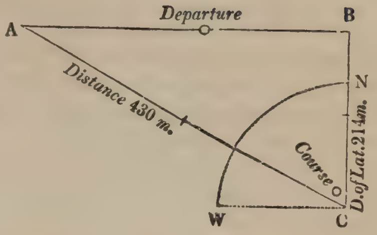
CASE IV.

The Distance and Difference of Latitude given, to find the Course and Departure.

Example. A ship from Cape St. Vincent, in latitude 37° 3′ N., sails between the north and west 430 miles, until her difference of latitude is 214 miles required her course steered, and departure made good.

BY CONSTRUCTION.

Draw the quadrant N C W to represent the N. W. quarter of the compass, and from C to B lay off the difference of latitude 214; through B draw the line A B parallel to C W; with the distance 430 in the compasses, place one foot in C, and let the other foot cross A B in A, and draw the line A C: then will the course B C A measure 60 degrees, and the departure A B 373.



BY CALCULATION.

To find the Course.

As the distance 430	2. 63347
Is to radius	10. 00000
So is the diff. of lat. 214	2. 33041
	12. 33041
	2. 63347
To co. sine of course 60° 9′	9. 69694

To find the Departure.

As radius	10. 00000
Is to distance 430	2. 63347
So is sine of course 60° 9′	9. 93819
	12. 57166
	10. 00000
To the departure 373	2. 57166

BY INSPECTION.

Seek in the several pages of the Traverse Tables until half the distance 215, and half the difference of latitude 107, are found opposite each other in their respective columns; against these will be found 186. 2, which being doubled, gives the whole departure 372. 4: and as the column where the difference of latitude is found, is marked *lat.* at bottom, the course is to be taken from thence, which in this example is 60 degrees.

BY GUNTER'S SCALE.

Extend from the distance 430 to the difference of latitude 214 on the line of numbers; that extent will reach from radius, or 90°, to 29° 51′, the complement of the course on the line of sines: hence the course is 60° 9′.

Extend from radius, or 90°, to the course 60° 9′ on the line of sines; that extent will reach from the distance 430 to the departure 373 on the line of numbers.

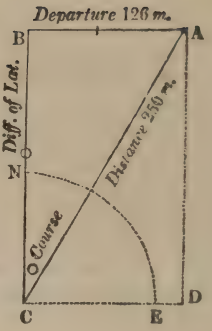
CASE V.

The Distance and Departure given, to find the Course and Difference of Latitude.

Example. A ship from latitude 1° 32′ S. sails between the north and east 250 miles, and finds she has made 126 miles of departure: required the course steered, and her latitude in.

BY CONSTRUCTION.

Draw the quadrant N C E to represent the N. E. quarter of the compass; from C to D lay off the departure 126, and through D draw the line D A parallel to C N produced; with the distance 250 in the compasses, place one foot in C, and let the other cut D A in A; draw the line A C, and through A draw the line B A parallel to C D; then the course B C A will measure 30° 16′, and the difference of latitude C B 215. 9.



BY CALCULATION.

To find the Course.	
As the distance 250	2. 39794
Is to radius	10. 00000
So is the departure 126	2. 10037
	12. 10037
	2. 39794
To sine of course 30° 16′	9. 70243

To find the Difference of Latitude.	
As radius	10. 00000
Is to the distance 250	2. 39794
So is co. sine of course 30°16′	9. 93636
	12. 33430
	10. 00000
To the diff. of lat. 215. 9	2. 33430

To find the Latitude in.

Latitude left..................	1°	32′	S.
Diff. of lat. 215. 9 miles, or	3	36	N.
Latitude in	2	4	N.

BY INSPECTION.

Seek in the Tables till opposite the distance 250, taken in its column; the nearest to the given departure 126 is found in its proper column, adjoining to which stands the difference of latitude 216. 5; and as the column in which the departure is found, is marked *dep.* at the top of the page, the course is to be taken from thence, which therefore will be 30 degrees.

BY GUNTER'S SCALE.

Extend from the distance 250 to the departure 126 on the line of numbers; that extent will reach from radius, or 90°, to the course 30° 16′ on the line of sines.

Extend from radius, or 90°, to the complement of the course 59° 44′ on the line of sines; that extent will reach from the distance 250 to the difference of latitude 216 on the line of numbers.

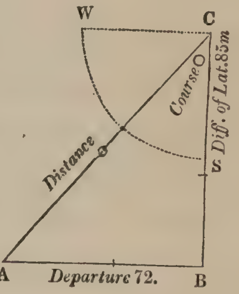
CASE VI

The Difference of Latitude and Departure given, to find the Course and Distance.

Example. A ship from Funchal, in Madeira, in latitude 32° 38′ N., sails a direct course between the south and west until she is in latitude 31° 13′ N. by observation, having made 72 miles of departure: required her course steered, and distance run.

Latitude of Funchal ……	32°	38′ N.	
Latitude in by observation	31	13 N.	
Difference of latitude …..	1	25	= 85 miles.

BY CONSTRUCTION.



Draw the meridian line c b, and from c describe the quadrant c s w; from c to b lay off the difference of latitude 85; through b draw a b parallel to c w, and equal to the departure 72, and join a c: then the course a c b will measure 40° 16′, and the distance a c 111. 4.

BY CALCULATION.

To find the Course.

As the diff. of latitude 85	1. 92942
Is to radius	10. 00000
So is the departure 72	1. 85733
	11. 85733
	1. 92942
To tang. of course 40° 16′	9. 92791

To find the Distance.

As radius	10. 00000
Is to the diff. of latitude 85	1. 92942
So is sec. of course 40° 16′	10. 11745
	12. 04687
	10. 00000
To the distance 111. 4	2. 04687

BY INSPECTION.

Seek in the different pages of the Tables till the difference of latitude 85, and the departure 72, or the nearest thereto, are found together in their respective columns, which will be under the course 40 degrees; and the distance answering to these will be 111.

Note. In this case, always seek for the larger of the two given numbers in the column marked *lat.* at the top of the page, until the smaller be found opposite to it in the column marked *dep.* at the top; observing, that when the departure is more than the difference of latitude, the course will be at the bottom of the page.

BY GUNTER'S SCALE.

Extend from the difference of latitude 85 to the departure 72 on the line of numbers; that extent will reach from radius, or 45°, to the course 40° 16′ on the line of tangents.

Extend from the complement of the course 49° 44′ to 90° on the line of sines; that extent will reach from the difference of latitude 85 to the distance 111. 4 on the line of numbers.

EXAMPLES FOR EXERCISE.

1. A ship from latitude 36° 30′ N., sails S. W. by W. 420 miles: what is her present latitude, and what departure has she made?
Answer. Latitude in 32° 37′ N., and departure 349. 3 miles.

2. A ship from latitude 3° 54′ S., has sailed N. W. $\frac{3}{4}$ W. till she arrives at latitude 2° 14′ N.: required her distance run, and departure made good.
Answer. Distance 617. 8, and departure 496. 2 miles.

3. A ship from St. Helena, in latitude 15° 55′ S., sails S. S. E. $\frac{1}{2}$ E. till she has made 115 miles of departure: I demand her present latitude, and the distance she has run.
Answer. Latitude in 19° 30′ S., and distance 244 miles.

4. A ship from latitude 28° 20′ N., sails north-easterly 486 miles, and finds by observation that she is in latitude 32° 17′ N.: what course has she steered, and what departure has she made?
Answer. Course N. 60° 49′ E., or N. E. b. E. $\frac{1}{2}$ E. nearly, and departure 424. 3 miles.

5. A ship sails between the north and west 170 leagues from a port, in latitude 38° 42′ N., until her departure is 98 leagues: required her course and latitude in.
Answer. Course N. 35° 12′ W., or N. W. b. N. $\frac{1}{4}$ W. nearly, and latitude in 45° 39′ N.

6. A ship from the Lizard, in latitude 49° 58′ N., sails to the westward on a direct course, till she arrives at latitude 48° 11′ N., and finds she has made 87 miles of westing: required her course steered, and distance run.
Answer. Course S. 39° 7′ W., or S. W. b. S. $\frac{1}{2}$ W. nearly, and distance 137. 9 miles.

7. A ship from Ascension Island, in latitude 7° 56′ S., sails N. N. W. $\frac{3}{4}$ W 244 miles: required her present latitude, and departure made good.
Answer. Latitude in 4° 27′ S., and departure 125. 4 miles.

8. A ship from Cape St. Vincent, in latitude 37° 3′ N., sails between the south and west, till her difference of latitude is 69 miles, and her departure 215 miles: required her course, distance, and latitude in.
Answer. Course S. 72° 12′ W., or W. S. W. $\frac{1}{2}$ W. nearly, distance 225. 7 miles, and latitude 35° 54′ N.

9. A ship from the Lizard, in latitude 49° 58′ N., sails 456 miles to the westward, and then finds she is 360 miles to the southward of the Lizard: required her course, departure, and latitude in.

Answer. Course S. 37° 52′ W., or S. W. ¾ S. nearly; departure 279. 9 miles, and latitude in 43° 58′ N.

10. A ship from Cape Hatteras, in latitude 35° 15′ N., sails in the north-east quarter 226 miles, and then finds that she is 198 miles to the eastward of the Cape: required her course, and latitude in.

Answer. Course N. 61° 11′ E., or N. E. by E. ½ E., and latitude in 37° 4′ N.

11. If a ship take her departure, at 6h. P. M., from Cape Verd, in latitude 14° 45′ N., and sail W. S. W. ½ W. at the rate of 7 miles an hour until the next day at noon; what will be her distance run, departure, and latitude in?

Answer. Distance 126 miles, departure 120. 6, and latitude in 14° 8′ N.

12. A ship from latitude 55° 30′ N., sails S. W. by S. during 20 hours, and then finds by observation she is in latitude 53° 17′ N.: required her rate of sailing per hour, and the departure she has made.

Answer. Departure 88. 87 miles, distance run in 20 hours 160 miles, and therefore her rate per hour 8 miles.

TRAVERSE SAILING.

WHEN a ship, either from contrary winds or other causes, is obliged to sail on different courses, the irregular or zigzag track she makes is called a TRAVERSE, or COMPOUND COURSE; and the method of reducing these several courses and distances into a single course and distance, is called resolving a traverse.

To resolve a traverse, make a Table (as that in Example I.), and divide it into six columns; in the first of these set down the several courses, and opposite to them, in the second column, their corresponding distances: the third and fourth columns are to be marked N. S. at the top, and are to contain the differences of latitude; the fifth and sixth are to be marked E. W., to contain the departures.

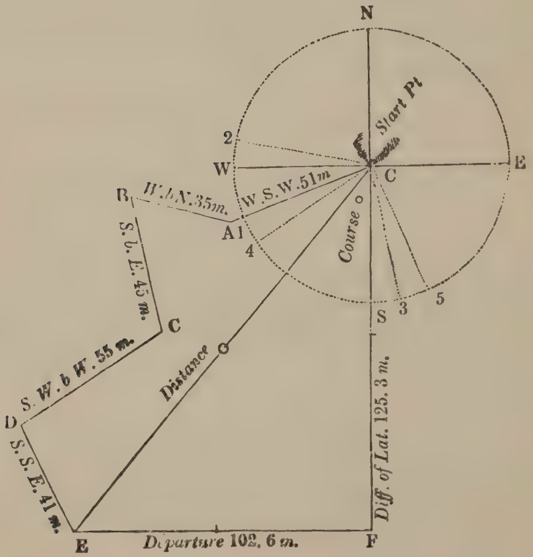
Find the difference of latitude and departure corresponding to each course and distance, by any of the methods in Case I. of Plane Sailing, the most common of which is that by Inspection; set these down opposite the distance in their proper columns, observing that the difference of latitude must be placed in the north column, if the course be northerly, and in the south column, if the course be southerly; and that the departure must be placed in the east column, if the course be easterly, and in the west column. if it be westerly. When the course is due north, south, east, or west, set down the distance in that column answering to it. Add up the columns of northing, southing, easting, and westing, and set down the sum of each at the bottom; then the difference between the sums of the north and south columns will be the whole difference of latitude made good, of the same name with the greater; and the difference between the sums of the east and west columns is the whole departure made good, of the same name with the greater sum.

With this whole difference of latitude and departure made good, find the direct course and distance, as in Case VI. of Plane Sailing.

EXAMPLE I.

Suppose a ship from the Start, in latitude 50° 13′ N., sail W. S. W. 51 miles, W. b. N. 35 miles, S. b. E. 45 miles, S. W. b. W. 55 miles, and S. S. E. 41 miles: required her direct course and distance sailed, and her latitude in.

BY CONSTRUCTION.



With the chord of 60° describe the circle N E S W, to represent the compass; draw the diameters N S and E W at right angles, the one representing the meridian, and the other the parallel the ship sailed from: take each course from the line of rhumbs, and lay them off from the meridian in their respective quarters, and number them in order 1, 2, 3, 4, &c.; thus, from S. to 1 lay off 6 points for the first course W. S. W.; from N. to 2 lay off 7 points for the second course W. b. N.; from S. to 3 lay off one point for the third course S. by E.; from S. to 4 lay off 5 points for the fourth course S. W. b. W.; from S. to 5 lay off 2 points for the fifth course S. S. E.; and from the centre of the circle draw rhumb lines to each of these points, which may be produced to any length that is necessary. Upon the first rhumb C 1, lay off the first distance 51 miles, from C to A; then will A represent the ship's place at the end of the first course; through A draw A B parallel to the second course C 2 (Prob. IV. Geom.), and make it equal to the second distance 35 miles; through B draw B C parallel to C 3, and equal to 45 miles: through C draw C D parallel to C 4, and equal to 55 miles; and through D draw D E parallel to C 5, and equal to 41 miles. Through E draw the line E F parallel to the east and west line W E, meeting N S produced in F, and join C E. Then will C F be the difference of latitude made good, measuring 125.3; E F the departure 102.6, C E the distance 162, and the angle E C F the course 39° 19′, or 3½ points.

TRAVERSE TABLE.

Courses.	Dist.	Diff. of Lat.		Departure.	
		N.	S.	E.	W.
W. S. W.	51		19.5		47.1
W. b. N.	35	6.8			34.3
S. b. E.	45		44.1	8.8	
S.W.b.W.	55		30.6		45.7
S. S. E.	41		37.9	15.7	
		6.8	132.1	24.5	127.1
			6.8		24.5
		Diff. of Lat.	125.3	Dep.	102.6

Lat. left............	50°	13′	N
Diff. of Lat. 125 or	2	5	S.
Latitude in	48	8	N.

To find the Course and Distance made good.

BY CALCULATION.

To find the Course.

As diff. of lat. 125.3	2.09795
Is to radius	10.00000
So is departure 102.6	2.01115
	12.01115
	2.09795
To tang. course 39° 19′	9.91320

To find the Distance.

As radius	10.00000
Is to diff. of latitude 125.3	2.09795
So is sec. of course 39° 19′	10.11145
	12.20940
	10.00000
To the distance 162	2.20940

Hence the direct course made good is S. 39° 19′ W. or S. W. b. S. ½ W., and the distance 162 miles.

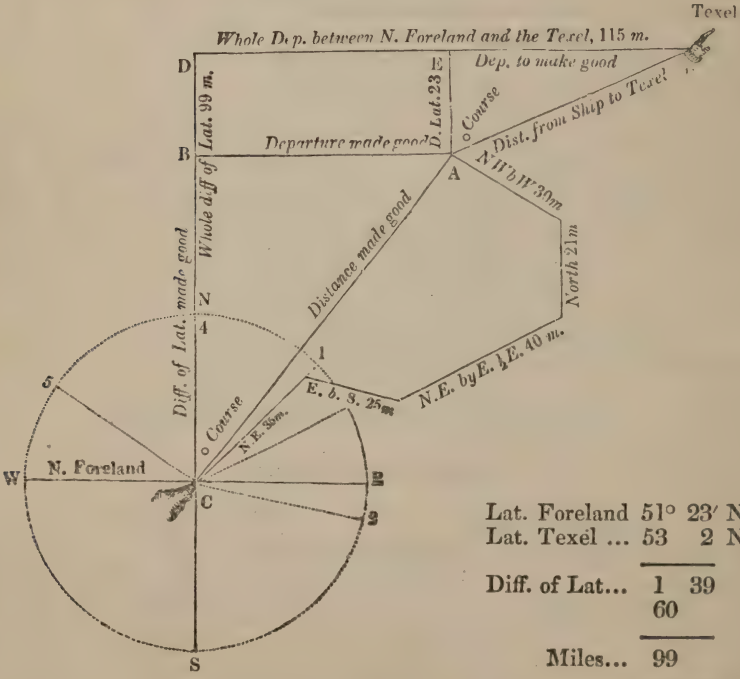
BY INSPECTION.

Seek in the Traverse Table till the difference of latitude 125. 3, and departure 102. 6, are found opposite each other in their respective columns; the nearest to these will be 125. 2 and 102. 8, which give the course $3\frac{1}{2}$ points at the top, and the distance 162 in its column.

EXAMPLE II.

A ship from the North Foreland, in latitude 51° 23′ N., and bound to the Texel, which lies in latitude 53° 2′ N., and 115 miles to the eastward, sails N. E. 35 miles, E. b. S. 25 miles, N. E. b. E. ½ E. 40 miles, North 21 miles, and N. W. b. W. 30 miles: required her course and distance made good, the latitude she is in, and departure from the meridian; also the direct course and distance from the ship to the Texel.

BY CONSTRUCTION.



Lat. Foreland	51° 23′	N.
Lat. Texel ...	53 2	N.
Diff. of Lat...	1 39	
	60	
Miles...	99	

With the chord of 60° describe a circle, through the centre of which draw the north and south, or meridian line, N. S., and at right angles to it the east and west line, W. E.; lay off from the meridian, upon the circumference of the circle, the several courses in their proper quarters, number them in order, and draw a rhumb line from the centre to each of the points; then, on the first rhumb line, which is N. E. or 4 points, lay off the distance 35 from the centre, and through the end of this first distance draw a line parallel to the second rhumb, E. b. S. 7 points, on which lay off the second distance 25; proceed thus till all the courses and distances are laid off, and through the end of the last distance draw the line A B parallel to the line W. E., meeting S. N. produced in B; then will A represent the ship's place, C B will measure the difference of latitude made good 76. 4, B A the departure 59. 6, C A the distance run 96.91, and the angle B C A the course steered, 37° 58′

To find what course the ship must steer, and what distance she must run, before she can arrive at the Texel, lay off from C to D 99, the whole difference of latitude between the Foreland and the Texel, and through D draw D F parallel to W. E., and equal to the whole departure 115, then will F represent the situation of the Texel: through A draw A E parallel to C D, and join A F; then A E will be the northing, or difference of latitude 23, and E F the easting, or departure 55. 4, the ship has to make good; A F the distance the ship has to sail 60, and the angle E A F measuring 67° 27, the course from the ship to the Texel.

TRAVERSE TABLE.

Courses.	Distance.	Diff. of Latitude.		Departure.	
		N.	S.	E.	W.
N. E.	35	24. 7		24. 7	
E. b. S.	25		4. 9	24. 5	
N. E. b. E. ½ E.	40	18. 9		35. 3	
North	21	21. 0			
N. W. b. W.	30	16. 7			24. 9
		81. 3	4. 9	84. 5	24. 9
		4. 9		24. 9	
	Diff. of Lat.	76. 4	Dep.	59. 6	

To find the Course and Distance made good.

BY CALCULATION.

To find the Course.

As diff. of latitude 76. 4	1. 88309
Is to radius	10. 00000
So is departure 59. 6	1. 77525
	11. 77525
	1. 88309
To tang course 37° 58′	9. 89216

To find the Distance.

As radius	10. 00000
Is to diff. latitude 76. 4	1. 88309
So is sec. course 37° 58′	10. 10327
	11. 98636
	10. 00000
To the distance 96. 91	1. 98636

BY INSPECTION.

The difference of latitude 76. 4, and departure 59. 6, being looked for till they are found opposite each other in their respective columns, give the course 38°, and the distance 97 miles.

To find the direct Course and Distance from the Ship to the Texel.

Latitude of N. Foreland ...	51° 23′ N.
Diff. of lat. made good, 76m. or	1 16 N.
Latitude in	52 39 N.
Latitude of Texel	53 2 N.
Diff. of latitude to make good	0 23 N.

Whole departure	115m. E.
Departure made good	59. 6 E.
Departure to make good ...	55. 4 E.

BY CALCULATION.

To find the Course.

As the diff. of latitude 23	1. 36173
Is to radius	10. 00000
So is departure 55. 4	1. 74351
	11. 74351
	1. 36173
To tang. course 67° 27′	10. 38178

To find the Distance.

As radius	10. 00000
Is to diff. of latitude 23	1. 36173
So is sec. course 67° 27′	10. 41625
	11. 77798
	10. 00000
To the distance 59. 98	1. 77798

BY INSPECTION.

The departure 55. 4, and difference of latitude 23, being looked for in the Tables till they are found together, the nearest numbers answering to them will be over the course 6 points, and opposite the distance 60 miles

EXAMPLES FOR EXERCISE.

1. A ship from the Lizard, in latitude 49° 58′ N., sails as follows. S. by W. 42 miles, W. S. W. 36 miles, West 18 miles, E. S. E. 22 miles, South 34 miles, and N E. 21 miles: required her present latitude, and the direct course and distance made good.

Answer. Her latitude in is 48° 35′ N., the course made good, S. 16° 27′ W., or S. by W. ½ W. nearly, and the distance 86. 13 miles.

2. A ship from latitude 9° 26′ N. sails N. E. 20 miles, North 33 miles. N. N. W. 15 miles, East 25 miles, N. E. by N. 42 miles, and S. W. ½ W. 28 miles: required her course and distance made good, and her present latitude.

Answer. Course N. 24° 12′ E., or N. N. E. ¼ E. nearly; distance 85. 63 miles, and present latitude 10° 44′ N.

3. A ship from the Cape of Good Hope, in latitude 34° 22′ S., sails S. W. ½ S. 27 miles, S. E. by E. 45 miles, S. W. by S. 48 miles, West 32 miles, and S. S. W. ½ W. 18 miles: required her course and distance made good, and her present latitude.

Answer. Course S. 24° 45′ W., or S. S. W. ¼ W., distance 112 miles, and latitude in 36° 4′ S.

4. A ship from latitude 1° 12′ S., sails E. by N. ½ N. 56 miles, N. ¼ E. 80 miles, S. by E. ½ E. 96 miles, N. ½ E. 68 miles, E. S. E. 40 miles, N. N. W. ½ W. 86 miles, and E. by S. 65 miles: required her direct course, distance, and her present latitude.

Answer. Course N. 51° 47′ E., or N. E. ½ E. nearly, distance 193. 8 miles, and present latitude 0° 48′ N.

5. A ship from latitude 46° 18′ N., sails N. 25° W. 50 miles, N. 74° E. 64 miles, S. 52° W. 36 miles, N. 35° E. 40 miles, N. 69° W. 75 miles, and S. 47° E. 48 miles: required her course, distance, and latitude in.

Answer. Course North, distance 67. 7 miles, and latitude in 47° 26′ N.

6. A ship from latitude 51° 30′ N., running at the rate of 8 knots an hour, sails W. S. W. 3 hours, N. W. 2½ hours, West 4 hours, S. W. by S. 2¼ hours, and N. W. ½ W. 2 hours: required her course, distance, and latitude in.

Answer. Course West, distance 90. 7 miles, and latitude in 51° 30′ N.

7. A ship from a Port in latitude 38° 42′ N., bound to another Port situated in latitude 36° 32′ N., and 137 miles to the eastward, sails the following courses: S. by W. ½ W. 55 miles, S. W. b. S. ½ W. 37 miles, South 60 miles, E. S. E. 40 miles, S. E. b. S. ¼ E. 32 miles, and N. E. b. E. ½ E. 58 miles: required her direct course and distance made good, her present latitude, and the direct course and distance to her intended Port.

Answer. The course made good is S. 23° 38′ E., and the distance 169 miles; the latitude in 36° 7′ N., the course to the intended Port N. 70° 8′ E., and the distance 73. 56 miles.

8. The course (by compass) from Beachy Head to Selsea Bill is N. 67° W. and distance 40 miles; from Selsea Bill to St. Catherine's Point N. 86° W. 21 miles; from St. Catherine's Point to Portland Lights N. 69° W. 44 miles; from Portland Lights to the Start N. 85° W. 49 miles: required the course and distance from Beachy Head to the Start.

Answer. The course is N. 75° 51′ W. or W. N. W. ¾ W., and distance 152. 2 miles.

9. Suppose a ship to sail upon the following courses and distances:— S. E. by S. 29 miles, N. N. E. 10, E. S. E. 50, E. N. E. 50, S. S. E. 10, N. E. by N. 29, West 25, S. S. E. 10, W. S. W. ½ W. 42, North 110, E. ¾ N. 62, North 7, West 62, North 10, West 8, South 10, West 62, South 7, E. ¾ S. 62, South 110, W. N. W. ½ W. 42, N. N. E. 10, and West 25 miles: required her course and distance made good.

Answer. The ship has returned to the place she sailed from.

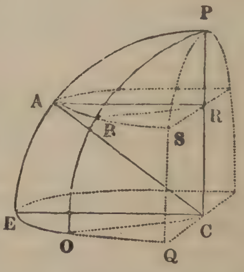
NOTE. This example is taken from "Robertson's Elements of Navigation;" the figure forming the shape of an Anchor.

PARALLEL SAILING.

In Plane Sailing it was observed that the meridians are considered as being all parallel to each other, and the length of a degree on the meridian and parallel every where equal; which supposition will give just conclusions, so far as the course, distance, difference of latitude, and departure, are concerned; because a ship, when sailing on a rhumb, makes equal angles with the meridians: but as the earth is a sphere, or globe, and the meridians meet at the Poles, it is evident that the distance between any two meridians must vary in every latitude, their greatest distance being at the Equator, on which the difference of longitude is measured: hence the difference of longitude always exceeds the departure, or meridian distance (except on the Equator, where they are the same), in proportion as the given places are situated further from the Equator.

Parallel Sailing is the method of finding the distance between two places in the same latitude when their difference of longitude is known, or of finding the difference of longitude answering to the meridian distance or departure made good, when a ship sails due east or west.

This sailing is particularly useful in making small or low islands, in which case it is usual to run into the latitude, and then steer due east or west.



The principles upon which Parallel Sailing depends, may be thus illustrated: Let PAEC represent a section of one-fourth part of the earth, through the centre C, and one of the Poles P; then PAE will be part of a meridian, PC the polar, and EC the equatorial, semi-axis; also let PBO represent part of another meridian, A and B two places in the same parallel, being equally distant from the Equator EOQ; then will AB be the meridian distance, and EO their difference of longitude; the arches AE or BO will measure their latitude, and AP or BP their co. latitude; AR, the radius of the parallel ABS, will be the sine of the arch AP, the co. latitude; or co. sine of AE the latitude of A or B. Now the angles ARB and ECO being equal, the arches AB and EO are similar; and as circles and similar arches of circles are in direct ratio to their radii, therefore

EC (or AC) : EO :: AR : AB.

That is, As radius,
Is to difference of longitude,
So is co. sine of latitude,
To the meridian distance.

Or, As radius,
Is to any given portion of the Equator
So is co. sine of latitude,
To a similar portion of a given parallel.

And, AR : AB :: EC (or AC) : EO.
That is, As co. sine of latitude
Is to meridian distance,
So is radius
To difference of longitude.

Also, EO : EC :: AB : AR.
That is, As difference of longitude
Is to radius,
So is meridian distance
To co. sine of latitude.

Hence, if a triangle, as ABC (see figure in Case I.), be so constructed that the longest side AC may represent the difference of longitude in miles, the base AB the meridian distance, and the angle opposite to it ACB the co. latitude, consequently the other angle BAC equal to the latitude, and any two of these parts be given, the other may be found by Trigonometry.

CASE I.

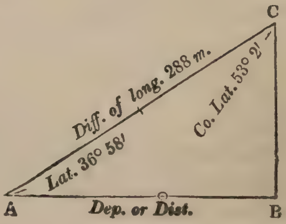
The Difference of Longitude between two Places, both in one Parallel of Latitude given, to find their Distance.

EXAMPLE. A ship in latitude 36° 58′ N., and longitude 20° 25′ W., is bound to St. Mary's, one of the Western Islands, in the same latitude, and in longitude 25° 13′ W., what distance must she run to arrive at the Island?

	90° 0′	Longitude of ship	20° 25′ W.
Latitude......	36 58	Longitude of St. Mary..	25 13 W.
Co. latitude...	53 2	Diff. of longitude	4 48=288 miles.

BY CONSTRUCTION.

Draw the line AB of any length, and make the angle CAB equal to the latitude 36° 58′ (Prob. XII. Geom.); from A to C lay off the difference of longitude 288, and from C draw CB perpendicular to AB (Prob. III. Geom.); then will AB measure 230, the departure or distance required.



BY CALCULATION.

To find the Departure or Distance.

As radius	10.00000
Is to the difference of longitude AC 288...	2.45939
So is the co. sine of latitude 36° 58′	9.90254
	12.36193
	10.00000
To the departure or distance AB 230.1..	2.36193

BY INSPECTION.

Seek for the complement of the latitude 53° among the degrees in the Traverse Table, as if it were a course, and for the difference of longitude 288 in one of the distance columns of that page, opposite to which, in the departure column, will be found 230, the departure or distance required.

BY GUNTER'S SCALE.

Extend from 90° to the co. latitude 53° 2′ on the line of sines; that extent will reach from the difference of longitude 288 to the distance 230.1 on the line of numbers.

CASE II.

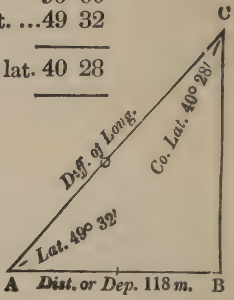
The Distance between two Places both in the same Parallel of Latitude given, to find the Difference of Longitude.

Example. A ship from latitude 49° 32′ N., and longitude 10° 16′ W., sails due West 118 miles: required her present longitude.

BY CONSTRUCTION.

Draw the line A B, which make equal to the given distance 118, and make the angle C A B equal to the latitude 49° 32′ (Prob. XII. Geom.); upon B erect the perpendicular B C, cutting the line A C in C (Prob. II. Geom.); then will the line A C measure 182, the difference of longitude required.

	90° 00′
Lat. ...	49 32
Co. lat.	40 28



BY CALCULATION.

To find the Diff. of Longitude.

As co. sine of lat. 49° 32′	9.81225
Is to the distance A B 118	2.07188
So is radius	10.00000
	12.07188
	9.81225
To the diff. of long. 181.8	2.25963

To find the Longitude in.

Longitude left	10°	16′ W.
Diff. of longitude 182m. or	3	2 W.
Longitude in	13	18 W.

BY INSPECTION.

Look for the co. latitude 40° in the Table, as a course, and for the distance 118 in one of the departure columns, opposite to which, in the distance column, will be found 184; but as the co. latitude is nearly half way between 40° and 41°, look again in the page with 41° at the top, for the distance 118 in one of the departure columns, and opposite, in the distance column, will be found 180; then half the sum of this and 184, found before, will be 182, the difference of longitude.

BY GUNTER'S SCALE.

Extend from the co. latitude 40° 28′ to radius 90° on the line of sines; that extent will reach from the distance 118 to the difference of longitude 182 miles.

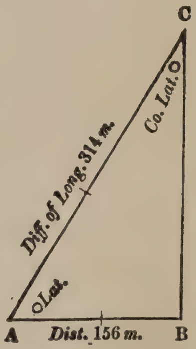
CASE III.

The Difference of Longitude and Distance between two Places in the same Parallel of Latitude given, to find the Latitude of that Parallel.

Example. A ship sails due East 156 miles, and then finds she has altered her longitude 314 miies: required the latitude of the parallel she has sailed on.

BY CONSTRUCTION.

Draw the line A B, and make it equal to the distance 156; on B erect the perpendicular B C, and with an extent in the compasses equal to the difference of longitude 314, set one foot in A, and with the other describe an arch cutting B C in C, and draw the line A C; then the angle C A B will measure 60° 13′ (Prob. XIII. Geom.), the latitude required.



BY CALCULATION.

To find the Parallel of Latitude sailed on.

As the difference of longitude A C 314 ...	2.49693
Is to radius	10.00000
So is the distance or departure A B 156 ...	2.19312
	12.19312
	2.49693
To co. sine of the latitude 60° 13′	9.69619

BY INSPECTION.

Seek in the several pages of the Table till half the difference of longitude and distance, *viz.* 157 and 78, (the whole exceeding the limits of the Table) are found opposite each other in the distance and departure columns, which will give the co. latitude 30° at the top of the page, and consequently the latitude required will be 60°.

BY GUNTER'S SCALE.

Extend from the difference of longitude 314 to the distance 156 on the line of numbers; that extent will reach from 90° to the complement of the latitude 29° 47′ on the line of sines: hence the latitude required is 60° 13′

EXAMPLES FOR EXERCISE.

1. A ship having taken her departure from North Cape, New Zealand, in latitude 34° 24′ S., and longitude 173° 10′ E., being bound to Port Jackson, sails due West until she arrives in longitude 163° 35′ E.: required her distance run.

Answer. Distance 474. 4 miles.

2. A ship from Buchanness, in latitude 57° 29′ N., and longitude 1° 47′ W., sails due East 125 miles: required her present longitude.

Answer. Longitude in 2° 6′ E.

3. A ship in latitude 32° 22′ N., and longitude 52° 20′ W., sails West 365 miles: required her distance from the Island of Bermuda, in the same latitude, and in longitude 64° 43′ W.

Answer. Distance of ship from Bermuda 262. 6 miles.

4. A ship in latitude 60° N., and longitude 22° 30′ W., sails West 200 miles: required her present longitude.

Answer. Longitude in 29° 10′ W.

5. If a ship take her departure from Cape St. Antonio (at the entrance to the River Plate), which lies in latitude 36° 19′ S., and longitude 56° 42′ W., how far must she sail due East to arrive at the meridian of the Cape of Good Hope, in longitude 18° 24′ E.?

Answer. 3631 miles.

6. In what parallel of latitude is the departure or meridian distance one third the difference of longitude?

Answer. In latitude 70° 32′.

7. A ship from longitude 81° 36′ W., sails West 310 miles, and then finds by observation she is in longitude 91° 50′ W.; on what parallel of latitude has she sailed?

Answer. In latitude 59° 41′.

8. Suppose a ship from latitude 35° 30′ N., and longitude 6° 15′ W., sails West 250 miles, North 525 miles, and then East 250 miles: required her present latitude and longitude.

Answer. Latitude 44° 15′ N., and longitude 5° 33′ W.

9. A ship from latitude 49° 32′ N., and longitude 21° 56′ W., sails N. W. by N. 20 miles, S. W. 40 miles, N. E. by E. 60 miles, S. E. 55 miles, W. by S. 41 miles, and E. N. E. 66 miles: required her present latitude and longitude.

Answer. Latitude 49° 32′ N., and longitude 20° 8′ W.

MIDDLE LATITUDE SAILING.

WHEN a ship sails due North or South, she keeps on the same meridian, and therefore does not change her longitude, and her distance run is the difference of latitude: consequently her place is easily determined by the latitude left, and difference of latitude. Again, when a ship sails due East or West, her difference of longitude is found by the latitude in, and departure or meridian distance, as already explained in Parallel Sailing; but when she sails upon any other course, she changes both her latitude and longitude. Now the difference of longitude cannot be inferred either from the departure, considered as a meridian distance in the latitude left, or that come to; for in the greater latitude it would give the difference of longitude too much, and in the lesser latitude too little: the departure is therefore accounted a meridian distance in the mean of the two latitudes, and then the difference of longitude is found as in Parallel Sailing; hence this method, which is compounded of Plane and Parallel Sailing, is called MIDDLE LATITUDE SAILING.

The middle latitude is half the sum of the two latitudes when they are of the same name; or half their difference, if of contrary names.*

This method of sailing, although not strictly accurate, especially in high latitudes, approaches sufficiently near the truth for a day's run; but it is used principally in low latitudes, and when the ship makes a course nearly east or west.

CASE I.

The Latitudes and Longitudes of two Places given, to find the Course and Distance between them.

EXAMPLE. Required the course and distance from Cape St. Vincent, in latitude 37° 3′ N., and longitude 9° 1′ W., to Funchal, in Madeira, in latitude 32° 38′ N., and longitude 16° 56′ W.

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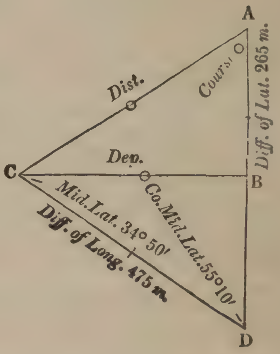
* The middle latitude computed as above, not being exactly the parallel in which the meridian distance is equal to the departure, the correct parallel, or as it may be called, the true middle latitude, may be found by the following proportion, *viz.*, Mer. diff. latitude : (proper) diff. latitude : : radius : co. sine (true) middle latitude; which proportion may be thus investigated :—

First, By Middle Latitude Sailing, diff. lat. : diff. long. : : co. sine middle lat. : tangent course; therefore, $\frac{\text{diff. long.} \times \text{co. si. mid. lat.}}{\text{diff. lat.}}$ = tangent course; and by Mercator's Sailing, Mer. diff. lat. : diff. long. : : radius : tangent course, or $\frac{\text{diff. long.} \times \text{radius}}{\text{Mer. diff. lat.}}$ = tangent course. Hence $\frac{\textit{diff. long.} \times \text{co. si. mid. lat.}}{\text{diff. lat.}} = \frac{\textit{diff. long.} \times \text{radius}}{\text{Mer. diff. lat.}}$, consequently Mer. diff. lat. × co. si. mid. lat. = radius × diff. lat., and therefore Mer. diff. lat. : radius : (proper) diff. lat. : : co. si. (true) middle latitude; or Mer. diff. lat. : (proper) diff. lat. : radius : co. sine (true) middle latitude.

Lat. Cape St. Vincent	37° 3′ N.	—	37° 3′	Long. C. St. Vinc.	9° 1′ W
Lat. Funchal	32 38 N.	—	32 38	Long. Funchal	16 56 W
Diff. of latitude	4 25	Sum 2)	69 41	Diff. of long.	7 55
	60				60
		Mid. lat.	34 50		
In miles	265		90 0	In miles	475
		Co. mid. lat.	55 10		

BY CONSTRUCTION.

Draw the line A D to represent the meridian of Cape St. Vincent; make the angle A D C equal to the co. mid. lat. 55° 10′, (Prob. XII. Geom.), and from D to C lay off the difference of longitude 475; from C draw the line B C perpendicular to A D, (Prob. III. Geom.); make B A equal to the difference of latitude 265, and draw the line A C: then will B C represent the departure 389. 9, the angle B A C the course 55° 48′, or 5 points nearly; and A C the distance 471. 5 miles.



BY CALCULATION.

To find the Departure.

As radius	10. 00000
Is to diff. of long 475	2. 67669
So is co. sine mid. lat. 34° 50′	9. 91425
	12. 59094
	10. 00000
To the departure 389. 9	2. 59094

To find the Course.

As diff. of latitude 265	2. 42325
Is to radius	10. 00000
So is departure 389. 9	2. 59095
	12. 59095
	2. 42325
To tang. course 55° 48′	10. 16770

*To find the Course without Dep.**

As diff. of lat. 265	2. 42325
Is to diff. of long. 475	2. 67669
So is co. sine mid. lat. 34° 50′	9. 91425
	12. 59094
	2. 42325
To tang. course 55° 48′	10. 16769

To find the Distance.

As radius	10. 00000
Is to the diff. of latitude 265	2. 42325
So is sec. course 55° 48′	10. 25020
	12. 67345
	10. 00000
To distance 471. 5	2. 67345

---

* This proportion is deduced from the two preceding, as may be thus demonstrated: first, rad. : diff. long. : : co. s. mid. lat. : depr.; therefore rad. × dep. = co. s. mid. lat. × diff long.; also, diff. lat. : rad. : : depr. : tang. course; therefore rad. × dep., = diff. lat. × tang. course; consequently diff. lat. × tang. course = co. s. mid. lat. × diff. long.; whence diff. lat. : co. s. mid. lat. : : diff. long. : tang. course; or, diff. lat. : diff. long. : : co. s. mid. lat. : tang. course.

Hence the course from Cape St. Vincent to Funchal is S. 55° 48 W., or S. W. b. W. nearly, and the distance 471. 5 miles.*

BY INSPECTION.

Look for the co. middle latitude 55°, as if it were a course, and for 237, half the difference of longitude (the whole being too great) in a distance column, immediately opposite to which, in the departure column, will be found 194. 1; this multiplied by 2, gives the departure 388. 2.

Then 132. 5, half the difference of latitude, and 194. 1, half the departure, being found nearly opposite each other in their respective columns, will give the course 56°, or 5 points, and half the distance 235, which multiplied by 2, gives the distance 470 miles.

BY GUNTER'S SCALE.

Extend from 90° to the complement of middle latitude 55° 10′ on the line of sines; that extent will reach from the difference of longitude 475 to the departure 389. 9 on the line of numbers.

Extend from the difference of latitude 265 to the departure 389. 9 on the line of numbers; that extent will reach from 45° to the course 55° 48′ on the line of tangents.

Extend from the complement of the course 34° 12′ to 90° on the line of sines; that extent will reach from the difference of latitude 265 to the distance 471. 5 on the line of numbers.

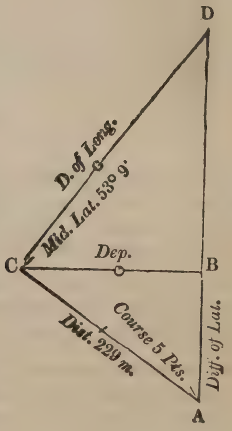
CASE II.

One Latitude, Course, and Distance given, to find the Difference of Latitude and Longitude.

Example. A ship from lat. 52° 6′ N., and long. 35° 6′ W., sails N.W.b.W 229 miles: required her present latitude and longitude.

BY CONSTRUCTION.

Draw the line A D, and make the angle D A C equal to the course 5 points; lay off, from A to C, the distance 229, and draw the line C B perpendicular to the line A D; then will the departure C B measure 190. 4, and the diff. of latitude A B 127: hence the latitude in is 54° 13′, and the middle latitude 53° 9′. Now make the angle B C D equal to the middle latitude 53° 9′, then will C D be the difference of longitude, measuring 317. 4 miles.



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* If the true middle latitude were found by the proportion given at the bottom of page 85 (34° 52′), the course would be 55° 47′, and the distance 471.3; the same exactly as found by Mercator's Sailing.

BY CALCULATION.

To find the Difference of Latitude.

As radius	10.00000
Is to distance 229	2.35984
So is co. sine course 5 pts.	9.74474
	12.10458
	10.00000
To the diff. of lat. 127.2	2.10458

Diff. of lat. 127 miles, or	2° 7′ N.
Latitude left	52 6 N
Latitude in	54 13 N.
Sum of latitudes	2) 106 19
Middle latitude	53 9
	90 0
Co. mid. latitude	36 51

To find the Departure.

As radius	10.00000
Is to distance 229	2.35984
So is sine course 5 pts.	9.91985
	12.27969
	10.00000
To the departure 190.4	2.27969

To find the Difference of Longitude.

As co. sine mid. lat. 53° 9′	9.77795
Is to departure 190.4	2.27967
So is radius	10.00000
	12.27967
	9.77795
To the diff. of long. 317.5	2.50172

*To find Diff. Longitude without Dep.**

As co. sine mid. lat. 53° 9′	9.77795
Is to diff. of lat. 127.2	2.10449
So is tang. course 5 pts.	10.17511
	12.27960
	9.77795
To the diff. of long. 317.4	2.50165

To find the Longitude in.

Longitude left	35° 6′ W.
Diff. of long. 317m. or	5 17 W.
Longitude in	40 23 W.

BY INSPECTION.

Look for the course 5 points at the bottom of the pages, over which, and opposite the distance 229 in its column, will be the diff. of latitude 127.2, and departure 190.4, in their respective columns.

Look for the co. mid. latitude 37° (being the nearest to 36° 51′) as if it were a course, and for half the departure 95.2 in its column, opposite the nearest to which, in the distance column, will be found 158; this, multiplied by 2, gives the difference of longitude, 316 miles.

---

* Or, by considering the whole figure A C D as an oblique-angled triangle, it may be stated thus: as co. sine mid. lat. is to distance so is sine course to diff. of longitude.

BY GUNTER'S SCALE.

Extend from 8 points to the complement of the course 3 points on the line of sine rhumbs; that extent will reach from the distance 229 to the difference of latitude 127. 2.

Extend from 8 points to the course 5 points on the line of sine rhumbs; that extent will reach from the distance 229 to the departure 190. 4.

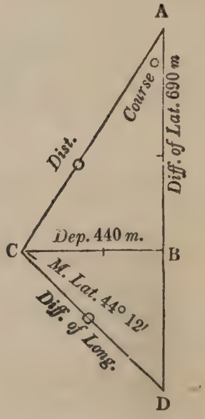
Extend from the co. mid. latitude 36° 51′ to 90° on the line of sines; that extent will reach from the departure 190. 4 to the difference of longitude 317. 4.

CASE III.

Both Latitudes and Departure given, to find the Course, Distance, and Difference of Longitude.

Example. A ship from latitude 49° 57′ N. and longitude 5° 11′ W sails between the South and West until she arrives in latitude 38° 27′ N. and finds she has made 440 miles of departure: required the course she has steered, the distance run, and the longitude she is in.

Latitude left	49° 57′ N.		49° 57′ N.
Latitude in	38 27 N.		38 27 N.
Diff. of latitude	11 30	Sum 2)	88 24
	60		
		Mid. lat.	44 12
In miles	690		90 00
		Co. mid. lat.	45 48



BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the difference of latitude 690; on B erect the perpendicular B C, which make equal to the departure 440, and join A C: draw the line C D, so as to make an angle with C B, equal to the middle latitude 44° 12′; then the course C A B will measure 32° 31′, the distance A C 818. 5, and the difference of longitude D C 613. 7

BY CALCULATION.

To find the Course.		*To find the Distance.*	
As diff. of latitude 690	2. 83885	As sine of course 32° 31′	9. 73042
Is to radius	10. 00000	Is to departure 440	2. 64345
So is departure 440	2. 64345	So is radius	10. 00000
	12. 64345		12. 64345
	2. 83885		9. 73042
To tang. course 32° 31′	9. 80460	To the distance 818. 5	2. 91303

To find the Difference of Longitude.

As co. sine mid. lat. 44° 12′	9. 85547
Is to departure 440	2. 64345
So is radius	10. 00000
	12. 64345
	9. 85547
To diff. of long. 613. 7	2. 78798

To find the Longitude in.

Longitude left	5° 11′ W
Diff. of long. 614m. or	10 14 W
Longitude in	15 25 W

BY INSPECTION.

One fourth the difference of latitude and departure, that is, 172. 5 and 110, are found to correspond nearly under 32° and 33°, the departure opposite the difference of latitude 172. 5, being too little under 32°, and too much under 33°; therefore the course is about 32½ degrees, and the distances answering to these are 203 and 206: their sum 409, divided by 2, gives one fourth the distance 204. 5, which, multiplied by 4, gives the whole distance 818.

The complement of middle latitude 46° taken as a course, with one-fourth the departure 110, in its column, gives in the distance column 153; this, multiplied by 4, will be the difference of longitude 612.

BY GUNTER'S SCALE.

Extend from the difference of latitude 690, to the departure 440 on the line of numbers; that extent will reach from 45° to the course 32° 31′ on the line of tangents.

Extend from the course 32° 31′ to 90° on the line of sines; that extent will reach from the departure 440 to the distance 818. 5 on the line of numbers.

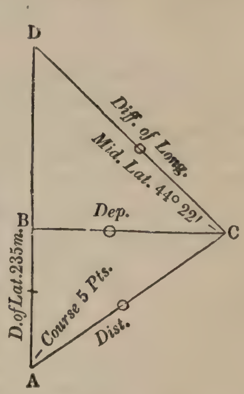
Extend from the co. mid. lat. 45° 48′ to 90° on the line of sines; that extent will reach from the departure 440 to the difference of longitude 613. 7 on the line of numbers.

CASE IV.

Both Latitudes and Course given, to find the Departure, Distance, and Difference of Longitude.

Example. A ship from latitude 42° 25′ N., and longitude 15° 6′ W., sails N. E. b. E. for several days, and then finds by observation that she is in latitude 46° 20′ N.: required the distance she has sailed, and her present longitude.

Latitude left	42° 25′ N.	....	42° 25′ N.
Latitude by obs.	46 20 N.	....	46 20 N.
Diff. of latitude	3 55	Sum 2)	88 45
	60		
		Mid. lat.	44 22
In miles	235		90 00
		Co. mid. lat.	45 38



BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the difference of latitude 235; on B erect the perpendicular B C, and make the angle B A C equal to the course 5 points; draw the line C D, making an angle equal to the middle latitude 44° 22′ with B C; then the departure B C will measure 352, the distance A C 423, and the difference of longitude D C 492.

BY CALCULATION

To find the Departure.

As radius	10. 00000
Is to diff. of latitude 235	2. 37107
So is tang. course 5 pts.	10. 17511
	12. 54618
	10. 00000
To the departure 351. 7	2. 54618

To find the Distance.

As co. sine of course 5 pts.	9. 74474
Is to diff. of latitude 235	2. 37107
So is radius	10. 00000
	12. 37107
	9. 74474
To the distance 423	2. 62633

To find the Difference of Longitude.

As co. sine mid. lat. 44° 22′	9. 85423
Is to departure 351. 7	2. 54617
So is radius	10. 00000
	12. 54617
	9. 85423
To diff. of longitude 492	2. 69194

To find the Longitude in.

Longitude left	15° 6′ W.
Diff. of long. 492m. or	8 12 E.
Longitude in	6 54 W.

BY INSPECTION.

Over the course 5 points, and opposite half the difference of latitude 117. 5, in its column, will be found half the departure 175. 4, and half the distance 211; these, multiplied by 2, give the whole departure 350. 8, and the distance 422.

The co. mid. lat. 45° 38′ being taken as a course between 45° and 46°, give opposite half the departure 175.4, in the distance columns, 248 and 244; half the sum of these, *viz.* 246, will be half the difference of longitude, which, multiplied by 2, gives the difference of longitude 492.

BY GUNTER'S SCALE.

Extend from the complement of the course 3 points to the course 5 points on the line of sine rhumbs; that extent will reach from the difference of latitude 235 to the departure 351.7 on the line of numbers.

Extend from the complement of the course 3 points to 8 points on the line of sine rhumbs; that extent will reach from the difference of latitude 235 to the distance 423 on the line of numbers.

Extend from the co. mid. lat. 45° 38′ to 90° on the line of sines; that extent will reach from the departure 351.7 to the difference of longitude 492 on the line of numbers.

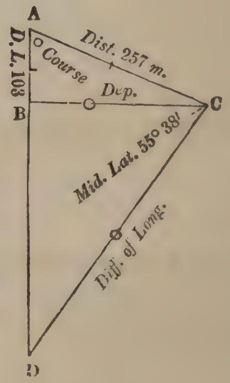
CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

Example. Suppose a ship from latitude 56° 30′ N. has sailed Southeasterly 257 miles when she arrives in latitude 54° 47′ N.; required her course, and difference of longitude.

Latitude left	56° 30′ N.		56° 30′ N.
Latitude in	54 47 N.		54 47 N.
Diff. of lat.	1 43	2)	111 17
	60		
		Mid. lat.	55 38
In miles	103		90 00
		Co. mid. lat.	34 22

BY CONSTRUCTION.



Draw the line A D, and from A to B lay off the difference of latitude 103; on B erect the perpendicular B C; and with the distance 257 in the compasses, placing one foot in A, let the other cross B C in C, and draw the line A C; draw C D, making with C B an angle equal to the middle latitude 55° 38′; then the course B A C will measure 66° 22′, and the difference of longitude C D 417.

BY CALCULATION.

To find the Course.

As the distance 257	2.40993
Is to radius	10.00000
So is diff. of lat. 103	2.01284
	12.01284
	2.40993
To co. sine course 66° 22′	9.60291

To find the Difference of Longitude.

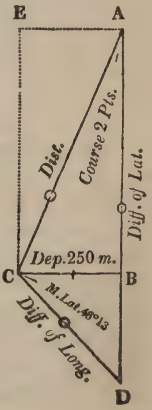
As co. sine mid. lat. 55° 38′	9.75165
Is to tang. course 66° 22′	10.35894
So is diff. lat. 103	2.01284
	12.37178
	9.75165
To diff. of longitude 417	2.62013

Note. We shall omit working this and the following Cases by Inspection and Gunter's Scale, as it is presumed the learner sufficiently understands those methods, without further instruction.

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

Example. A ship sails S. S. W. from latitude 51° 15′ N., and longitude 9° 50′ W., until her departure is 250 miles required the distance sailed, and her present latitude and ongitude.



BY CONSTRUCTION

Having drawn the line A D, make A E perpendicular to it, and equal to the departure 250; through E draw E C parallel to A D, and draw A C, making an angle with A D, equal to the course 2 points; draw C B parallel to A E, and the line C D, making an angle with C B, equal to the middle latitude 46° 13′; then will the difference of latitude A B, measure 603. 6, the distance A C 653. 3, and the difference of longitude C D 361. 3.

To find the Difference of Latitude.

As sine of course 2 pts.	9.58284
Is to departure 250	2.39794
So is co. sine of course 2 pts.	9.96562
	12.36356
	9.58284
To the diff. of lat. 603. 6	2.78072

Latitude left	51°	15′	N
Diff. of latitude 604m. or	10	4	S.
Latitude in	41	11	N
Sum of latitudes 2)	92	26	
Middle latitude	46	13	
	90	00	
Co. mid. latitude	43	47	

To find the Distance.

As sine of course 2 pts.	9.58284
Is to departure 250	2.39794
So is radius	10.00000
	12.39794
	9.58284
To the distance 653.3	2.81510

To find the Difference of Longitude.

As co. sine mid. lat. 46° 13′	9.84006
Is to departure 250	2.39794
So is radius	10.00000
	12.39794
	9.84006
To the diff. of long. 361.3	2.55788

Longitude left	9°	50′	W.
Diff. of longitude 361 miles, or	6	1	W.
Longitude in	15	51	W.

CASE VII.

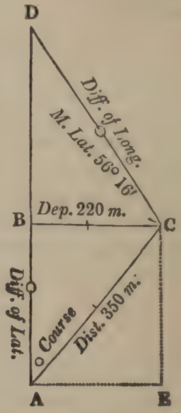
One Latitude, Distance, and Departure given, to find the Course, Difference of Latitude, and Difference of Longitude.

Example. A ship from latitude 54° N., and longitude 33° 20′ W., sails 350 miles, between the North and East, until she has made 220 miles of departure: required the course steered, and her present latitude and longitude.

BY CONSTRUCTION.

Draw the line A D, and make A E perpendicular to it, and equal to the departure 220: through E draw E C parallel to A D, and, with the distance 350 in the compasses, set one foot in A, and let the other cross C E in C; join A C, and draw B C parallel to A E; then the course B A C will measure 38° 57′, and the difference of latitude A B 272.2: hence the latitude in will be 58° 32′, and the mid. lat. 56° 16′.

Make the angle B C D equal to 56° 16′, and the difference of longitude D C will measure 396.2.



BY CALCULATION.

To find the Course.

As the distance 350	2.54407
Is to radius	10.00000
So is departure 220	2.34242
	12.34242
	2.54407
To sine of course 38° 57′	9.79835

To find the Difference of Latitude.

As radius	10.00000
Is to distance 350	2.54407
So is co. sine of course 38° 57′	9.89081
	12.43488
	10.00000
To the diff. of lat. 272.2	2.43488

Latitude left	54° 0′ N.	
Diff. of lat. 272m. or	4 32 N.	
Latitude in	58 32 N.	
	Sum of latitudes 2)	112 32
	Mid. latitude	56 16
		90 00
	Co. mid. latitude	33 44

To find the Difference of Longitude.

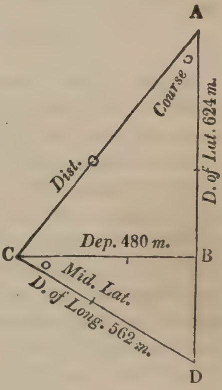
As co. sine mid. lat. 56° 16′	9.74455
Is to departure 220	2.34242
So is radius	10.00000
	12.34242
	9.74455
To the diff. of long. 396.2	2.59787

Longitude left	33° 20′ W.
Difference of longitude 396 miles, or	6 36 E.
Longitude in	26 44 W.

CASE VIII.

*One Latitude, Departure, and Difference of Longitude given, to find the other Latitude, Course, and Distance.**

EXAMPLE. A ship from latitude 36° 32′ N. sails between the South and West until she has made 480 miles of departure, and 562 miles of difference of longitude: required her present latitude, course steered, and distance run.



BY CONSTRUCTION.

Having drawn the line A D, make B C perpendicular to it, and equal to the departure 480; draw C D equal to the difference of longitude 562, meeting A D in D; then the middle latitude B C D will measure 31°20′; hence the latitude in is 26° 8′, and the difference of latitude 624: now make A B equal to 624, and join A C, which will measure the distance 787.2, and the course C A B will be 37° 34′.

BY CALCULATION.

To find the Middle Latitude.

As the diff. of long. 562	2.74974
Is to radius	10.00000
So is departure 480	2.68124
	12.68124
	2.74974
To co. sine mid. lat. 31°20′	9.93150

Middle latitude	31° 20′
	2
Double mid. lat.	62 40
Latitude left	36 32 N.
Latitude in	26 8 N.
Diff. of lat.	10 24 = 624 m.

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* This Case cannot be solved by Mercator's Sailing.

To find the Course.

As diff. of lat. 624	2. 79518
Is to radius	10. 00000
So is departure 480	2. 68124
	12. 68124
	2. 79518
To tang. course 37° 34′	9. 88606

To find the Distance.

As radius	10. 00000
Is to diff. of lat. 624	2. 79518
So is sec. course 37° 34′	10. 10092
	12. 89610
	10. 00000
To the distance 787. 2	2. 89610

MERCATOR'S SAILING.

MERCATOR'S SAILING is the art of finding on a plane surface the motion of a ship upon any assigned course of the compass which shall be true in latitude, longitude, and distance sailed. This method is derived from the projection of Mercator's Chart, in which the degrees of longitude are every where equal, the degrees of latitude increase towards the poles, and the parallels, meridians, and rhumb-lines are all represented by strait lines.

Charts, in which the degrees of longitude and latitude are every where equal, are termed PLANE CHARTS. These, it must appear obvious from what has been said in Parallel and Middle Latitude Sailing, are constructed on erroneous principles; and it is also evident that their error must increase in proportion as the places are more remote from the Equator; but the great inconvenience of using curved lines on a plane surface, induced mariners, notwithstanding their incorrectness, to use the Plane Charts, till Mr. Gerrard Mercator, about the year 1556, published a chart, in which he continued the meridians all parallel to each other, thereby extending the degrees of longitude beyond their proper length; but, in order to compensate for this expansion of the degrees of longitude, he enlarged the meridional lines, that is, increased the distance between the parallels, so that the proportion between a degree of latitude and longitude might be every where preserved on the chart, at the same time that the meridians, parallels, and rhumbs would be all projected into strait lines: whence a chart thus constructed has obtained the name of MERCATOR'S CHART. It does not, however, appear that Mercator understood the true principles of this projection, as he did not enlarge the meridional degrees in their just proportion.

In the year 1599, Mr. Edward Wright, of Caius College, Cambridge, published the true principles of Mercator's Chart, in a work entitled "*The Correction of certain Errors in Navigation*;" where he shewed, by a Table of *Meridional Parts*, the length of the enlarged meridians in miles of the equator to every minute of latitude, and which Table he constructed according to the following principles :—

It has been already demonstrated in Parallel Sailing, that the length of any portion of a parallel is to a similar portion of the equator as the co. sine of the latitude is to radius; but the meridians and equator being equal on the globe, therefore the length of any portion of a parallel is to a similar portion of a meridian, as co. sine of the latitude is to radius; or, which is the same thing, as radius is to the secant of the latitude. Now, if the meridians are made parallel to each other, the length of a degree or minute of longitude will remain the same in every latitude as at the equator, by which they will be enlarged beyond their proper length in the ratio of radius to secant of the latitude; therefore, the length of the meridional degrees or minutes must be likewise increased in the same proportion. Hence the length of the first minute, or mile of latitude, from the equator will be represented by the secant 1′, (the length of a mile on the equator being radius); the second mile by the secant of 2′; the third mile by the secant of 3′, &c.: consequently the length of the meridional line to any latitude will be equal to the sum of the secants of all the intermediate miles between the equator and the given latitude.

This method of constructing meridional parts is not strictly accurate, because the secants should be taken to every point of latitude; but as the tables of meridional parts are seldom carried to decimals, the error is of no consequence in any navigable latitude. However, more accurate and expeditious methods have been since invented for the same purpose.

To find the length of the expanded meridian between any two parallels of latitude, or, as it is called, the meridional difference of latitude, the same rules are to be observed as in finding the true or proper difference of latitude—that is, if the latitudes are of the same name, the difference of their corresponding meridional parts (taken from Table III.); but if the latitudes are of contrary names, the sum of those parts will be the meridional difference of latitude.

From the principles of Mercator's Chart it is proved, that if A B (see the figure in Case I.) represent the true or proper difference of latitude between two places, the angle B A C the course, A C the true distance, B C the departure, as in Plane Sailing; and if we produce A B to D till it be equal to the enlarged or meridional difference of latitude, and draw D E parallel to B C, then will D E represent the difference of longitude. Now the triangles A B C and A D E are similar, the angle A being common to both, and the sides B C and D E parallel; therefore, as A B : B C :: A D : D E—that is, as the proper difference of latitude is to the departure, so is the meridional difference of latitude to the difference of longitude. Hence, likewise, in the triangle A D E, making A D radius, we have—As radius : A D :: tang. angle A : E D; that is, as radius is to mer. diff. of latitude, so is tangent of the course to the difference of longitude; or, making A E radius—As co. sine angle A : A D :: sine angle A : E D; that is, as co. sine of the course is to mer. diff. of latitude, so is sine of the course to the diff. of longitude: which proportions, with others derived from these triangles, will resolve all the Cases in Mercator's Sailing.

In the following Cases, except the eighth, the same examples are introduced as in Middle Latitude Sailing, in order that a comparison may be made between the two methods.

CASE I.

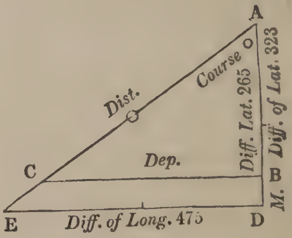
The Latitudes and Longitudes of Two Places given, to find the Course and Distance between them.

Example. Required the course and distance from Cape St. Vincent, in latitude 37° 3′ N. and longitude 9° 1′ W. to Funchal, in Madeira, in latitude 32° 38′ N. and longitude 16° 56′ W.

Lat. Cape St. Vinc.	37° 3′ N.	Mer. parts	2396	Long. C. St. Vin.	9° 1 W.
Lat. Funchal	32 38′ N.	Mer. parts	2073	Long. Funchal	16 56 W.
Diff. of latitude	4 25	Mer. diff. of lat.	323	Diff. of long.	7 55
	60				60
In miles	265			In miles	475

BY CONSTRUCTION.

Draw the line A D to represent the meridian of Cape St. Vincent, upon which lay off the meridional difference of latitude 323; on D erect the perpendicular D E (Prob. II. or XII. Geom.); make it equal to the difference of longitude 475, and draw the line A E; from A to B lay off the proper difference of latitude 265, and through B draw B C parallel to D E; then will the angle E A D be the course, measuring 55° 47′, or 5 points nearly, and A C the distance, 471 miles.



BY CALCULATION.

To find the Course.

As mer. diff. of lat. 323	2.50920
Is to radius	10.00000
So is diff. of long. 475	2.67669
	12.67669
	2.50920
To tang. course 55° 47′	10.16749

To find the Distance.

As radius	10.00000
Is to prop. diff. lat. 265	2.42325
So is sec. course 55° 47′	10.25001
	12.67326
	10.00000
To the distance 471.3	2.67326

Hence the direct course from Cape St. Vincent to Funchal is S 55° 47′ W or S. W. b. W. nearly, and the distance 471 miles.

BY INSPECTION

Seek in the Tables for half the merid. diff. of lat. 161. 5, and half the diff of longitude 237. 5, till they are found against each other in the lat. and dep. columns: the nearest to these are 160. 5 and 237. 9 in that page marked 56° at the bottom, which is the course; over that course, and opposite half the proper diff. of latitude, 132. 5 in its column, is found, in the dist. column, 237, which multiplied by 2, gives the distance required. 474 miles.

BY GUNTER'S SCALE.

Extend from the mer. diff. of lat. 323 to the diff. of long. 475 on the line of numbers; that extent will reach from 45° to the course 55° 47 on the line of tangents.

Extend from the complement of the course 34° 13′ to 90° on the line of sines; that extent will reach from the proper diff. of lat. 265, to the distance 471 on the line of numbers.

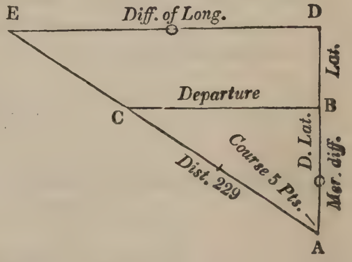
CASE II.

One Latitude, Course, and Distance given, to find the Difference of Latitude and Difference of Longitude.

Example. A ship from latitude 52° 6′ N. and longitude 35° 6′ W sails N. W. b. W. 229 miles: required her present latitude and longitude.

BY CONSTRUCTION.

Draw the line A D, and make the angle D A E equal to the course 5 points; from A to C lay off the distance 229, and from C draw C B perpendicular to A D; then will A B measure the diff. of latitude 127: hence the latitude come to is 54° 13′, and the mer. diff. of latitude 212; make A D equal to 212, and draw D E parallel to B C; then will the difference of longitude D E measure 317. 3.



BY CALCULATION.

To find the Difference of Latitude.

As radius	10. 00000
Is to distance 229	2. 35984
So is co. sine course 5 pts.	9. 74474
	12. 10458
	10. 00000
To the diff. of lat. 127. 2	2. 10458

To find the Latitude in.

Lat. left	52° 6′ N.	Mer. pts. 3675
Diff. of lat.	2 7 N.	
Lat. in	54 13 N.	Mer. pts. 3887
		Mer. diff. of lat. 212

To find the Difference of Longitude.

As radius	10.00000
Is to mer. diff. lat. 212	2.32634
So is tang. course 5 pts.	10.17511
	12.50145
	10.00000
To diff. of longitude 317.3	2.50145

To find the Longitude in.

Longitude left	35° 6′ W
Diff. of long. 317m. or	5 17 W.
Longitude in	40 23 W.

BY INSPECTION.

Over the course 5 points, and opposite the distance 229, is the difference of latitude 127.2: hence the latitude come to is 54° 13′, and the mer. diff. of lat. 212; then over the course 5 points, and opposite half the mer. diff. of lat. 106, in a lat. column, will be found 158.8 in a dep. column, which, multiplied by 2, gives the diff. of longitude 317.6.

BY GUNTER'S SCALE.

Extend from 8 points to the complement of the course 3 points on the line of sine rhumbs; that extent will reach from the distance 229 to the difference of latitude 127.2 on the line of numbers.

Extend from 4 points to the course 5 points on the line of tangent rhumbs; that extent will reach from the mer. diff. of latitude 212 to the diff. of longitude 317.3.

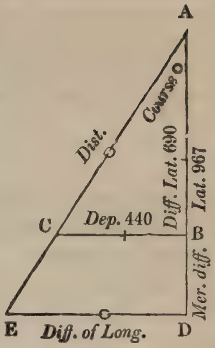
CASE III.

Both Latitudes and Departure given, to find the Course, Distance, and Difference of Longitude.

Example. A ship from latitude 49° 57′ N. and longitude 5° 11′ W. sails between the South and West until she arrives in latitude 38° 27′ N., and finds she has made 440 miles of departure: required the course she has steered, the distance run, and the longitude she is in.

Latitude left	49° 57′ N.	Mer. parts	3470
Latitude in	38 27 N.	Mer. parts	2503
Diff. of latitude	11 30	Mer. diff. latitude	967
	60		
Miles	690		

BY CONSTRUCTION.



Having drawn the line A D, make A B equal to the proper diff. of latitude 690; on B erect the perpendicular B C, and make it equal to the departure 440; also make A D equal to the meridional diff. of latitude 967, and draw D E parallel to B C; through A and C draw the line A E, meeting D E in E; then will the angle C A B be the course 32° 31′, A C the distance 818. 5, and D E the difference of longitude 616. 5.

BY CALCULATION.

To find the Course.

As diff. of latitude 690	2. 83885
Is to radius	10. 00000
So is departure 440	2. 64345
	12. 64345
	2. 83885
To tang. course 32° 31′	9. 80460

To find the Distance.

As sine of course 32° 31′	9. 73042
Is to departure 440	2. 64345
So is radius	10. 00000
	12. 64345
	9. 73042
To the distance 818. 5	2. 91303

*To find the Difference of Longitude.**

As radius	10. 00000
Is to mer. diff. lat. 967	2. 98543
So is tang. course 32° 31′	9. 80447
	12. 78990
	10. 00000
To diff. of long. 616. 5	2. 78990

To find the Longitude in

Longitude left	5° 11′ W.
Diff. of long. 616m. or	10 16 W.
Longitude in	15 27 W

BY INSPECTION.

One fourth the difference of latitude and departure, that is, 172. 5 and 110, are found to correspond nearly under 32° and 33°, the departure opposite the difference of latitude 172. 5, being too little under 32°, and too much under 33°: therefore the course is about 32½ degrees, and the distances answering to these are 203 and 206: their sum 409, divided by 2, gives one fourth the distance 204. 5, which, multiplied by 4, gives the whole distance 818.

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* Or, since the triangles A B C and A D E are similar, the difference of longitude may be found independent of the course; for as A B : B C :: A D : D E; that is, as the proper diff. of lat. is to the dep., so is the mer. diff. of lat. to the diff. of longitude.

One fourth the mer. diff. of latitude 241. 7, in one of the lat. columns of the page marked with the course 32° at the top, gives in the dep. column 151. 0; and the same with the course 33° at the top, gives 156. 9 ; the sum of these is 307. 9, which, divided by 2, gives 153. 9 ; this multiplied by 4, gives the difference of longitude 615. 6.

BY GUNTER'S SCALE.

Extend from the difference of latitude 690 to the departure 440 on the line of numbers ; that extent will reach from 45° to the course 32° 31′ on the line of tangents.

Extend from the course 32° 31′ to 90° on the line of sines ; that extent will reach from the departure 440 to the distance 818. 5 on the line of numbers.

Extend from 45° to the course 32° 31′ on the line of tangents ; that extent will reach from the meridional diff. of latitude 967, to the difference of longitude 616. 5, on the line of numbers.

CASE IV.

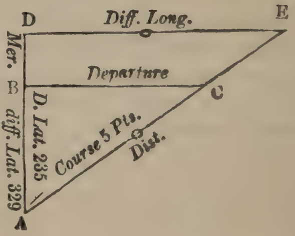
Both Latitudes and Course given, to find the Distance, and Difference of Longitude.

Example. A ship from latitude 42° 25′ N., and longitude 15° 6′ W., sails N. E. b. E. for several days, and then finds by Observation that she is in latitude 46° 20′ N.: required the distance she has sailed, and her present longitude.

Latitude left	42° 25′ N.	Mer. parts	2815
Latitude in by Obs.	46 20 N.	Mer. parts	3144
Diff. of latitude	3 55	Mer. diff. latitude	329
	60		
In miles	235		

BY CONSTRUCTION.

Draw the line A D, and from A to B lay off the diff. of lat. 235 ; on B erect the perpendicular B C, and make the angle B A C equal to the course 5 points ; lay off the mer. diff. of lat. 329 from A to D, and through D draw D E parallel to B C ; then the distance A C will measure 423, and the diff. of longitude D E 492.



BY CALCULATION.

To find the Distance.		*To find the Difference of Longitude.*	
As co. sine of course 5 pts.	9.74474	As radius	10.00000
Is to diff. of latitude 235	2.37107	Is to mer. diff. of lat. 329	2.51720
So is radius	10.00000	So is tang. course 5 pts.	10.17511
	12.37107		12.69231
	9.74474		10.00000
To the distance 423	2.62633	To diff. of long. 492.4	2.69231

Longitude left	15°	6′	W.
Difference of longitude 492 miles, or	8	12	E.
Longitude in	6	54	W.

BY INSPECTION.

Over the course 5 points, and opposite half the difference of latitude 117.5 in its column, will be found half the distance 211 in its proper column; this multiplied by 2, gives the whole distance 422.

Over the same course, and opposite half the mer. diff. of latitude 164.5, found in a latitude column, stands 246.1 in the corresponding dep. column; which, multiplied by 2, gives the diff. longitude 492.2.

BY GUNTER'S SCALE.

Extend from the complement of the course 3 points to 8 points on the line of sine rhumbs; that extent will reach from the difference of latitude 235 to the distance 423 on the line of numbers.

Extend from 4 points to the course 5 points on the line of tangent rhumbs; that extent will reach from the mer. diff. of lat. 329, to the diff. of longitude 492.4 on the line of numbers.

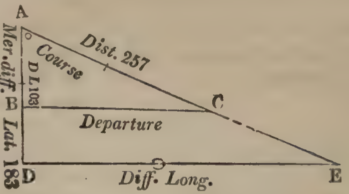
CASE V.

Both Latitudes and Distance given, to find the Course and Difference of Longitude.

Example. Suppose a ship from latitude 56° 30′ N. has sailed Southeasterly 257 miles, when she arrives at latitude 54° 47′ N.: required her course steered, and difference of longitude.

Latitude left	56° 30′ N.	Mer. parts	4128
Latitude in	54 47 N.	Mer. parts	3945
Diff. of latitude	1 43	Mer. diff. latitude	183
	60		
Miles	103		

BY CONSTRUCTION



Draw the line A D, and from A to B lay off the diff. of latitude 103; on B erect the perpendicular B C, and with the distance 257 in the compasses set one foot in A, and with the other describe an arch cutting B C in C, and draw the line A C; from A to D lay off the mer. diff. of latitude 183, and through D draw D E parallel to B C, meeting A C produced in E; then the course B A C will measure 66° 22′, and the diff. of longitude D E 418. 2.

BY CALCULATION.

To find the Course.

As the distance 257	2. 40993
Is to radius	10. 00000
So is diff. of lat. 103	2. 01284
	12. 01284
	2. 40993
To co. sine course 66° 22′	9. 60291

To find the Difference of Longitude.

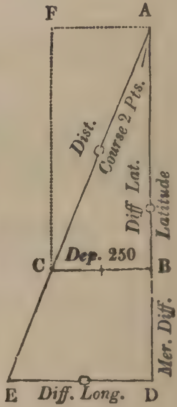
As co. sine course 66° 22′	9. 60302
Is to mer. diff. lat. 183	2. 26245
So is sine course 66° 22′	9. 96196
	12. 22441
	9. 60302
To diff. of longitude 418. 2	2. 62139

CASE VI.

One Latitude, Course, and Departure given, to find the Distance, Difference of Latitude, and Difference of Longitude.

Example. A ship sails S. S. W. from latitude 51° 15′ N., and longitude 9° 50′ W. until her departure is 250 miles: required the distance sailed, and her present latitude and longitude.

BY CONSTRUCTION.



Draw A D, and make A F perpendicular to it, on which lay off from A to F the dep. 250; through F draw F C parallel to A D, and draw A C, making an angle with A D equal to the course 2 points, meeting F C in C, through which draw C B parallel to F A; then will the distance A C measure 653, and the diff. of latitude A B 604: hence the latitude in is 41° 11′, and the mer. diff. of lat. 877; from A to D lay off 877, and draw D E parallel to B C or F A, meeting A C produced in E; then will the diff. of longitude D E measure 363. 3.

BY CALCULATION.

To find the Difference of Latitude.

As sine of course 2 pts.	9.58284
Is to departure 250	2.39794
So is co. sine of course 2 pts.	9.96562
	12.36356
	9.58284
To the diff. of lat. 603.6	2.78072

Lat. left	51° 15′ N.	Mer. pts.	3593
Diff. lat.	10 4 S.		
Lat. in	41 11 N.	Mer. pts.	2716
		Mer. diff. lat.	877

Longitude left	9° 50′ W.
Diff. of long. 363m. or	6 3 W.
Longitude in	15 53 W.

To find the Distance.

As sine of course 2 pts.	9.58284
Is to departure 250	2.39794
So is radius	10.00000
	12.39794
	9.58284
To the distance 653.3	2.81510

To find the Difference of Longitude.

As co. sine of course 2 pts.	9.96562
Is to mer. diff. lat. 877	2.94300
So is sine course 2 pts.	9.58284
	12.52584
	9.96562
To the diff. of long. 363.3	2.56022

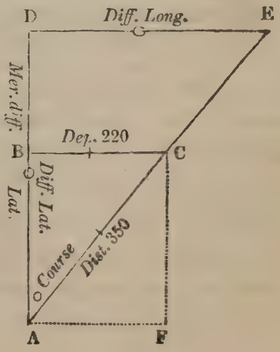
CASE VII.

One Latitude, Distance, and Departure given, to find the Course, Difference of Latitude, and Difference of Longitude.

Example. A ship from latitude 54° N., and longitude 33° 20′ W., sails 350 miles between the North and East until she has made 220 miles of departure: required the course steered, and her present latitude and longitude.

BY CONSTRUCTION.

Draw A D and A F perpendicular to it, which make equal to the departure 220; through F draw F C parallel to A D, and with the distance 350 in the compasses, set one foot in A, and with the other draw an arch cutting F C in C; join A C, and draw B C parallel to A F; then the course B A C will measure 38° 57′, and the difference of lat. A B 272.2: hence the latitude in is 58° 32′, and mer. diff. of latitude 490; from A to D lay off 490, and through D draw D E parallel to A F or B C, meeting A C produced in E; then the diff. of longitude D E will measure 396.1



BY CALCULATION.

To find the Course.

As the distance 350	2.54407
Is to radius	10.00000
So is departure 220	2.34242
	12.34242
	2.54407
To sine of course 38° 57′	9.79835

To find the Difference of Latitude.

As radius	10.00000
Is to distance 350	2.54407
So is co. sine course 38° 57′	9.89081
	12.43488
	10.00000
To the diff. of lat. 272.2	2.43488

Lat. left	54° 0′	N.	Mer. pts.	3865
Diff. lat.	4 32	N.		
Lat. in	58 32	N.	Mer. pts.	4355
			Mer. diff. lat.	490

Longitude left	33° 20′	W.
Diff. of long. 396m. or	6 36	E.
Longitude in	26 44	W.

To find the Difference of Longitude.

As co. sine course 38° 57′	9.89081
Is to mer. diff. lat. 490	2.69020
So is sine course 38° 57′	9.79840
	12.48860
	9.89081
To diff. of long. 396.1	2.59779

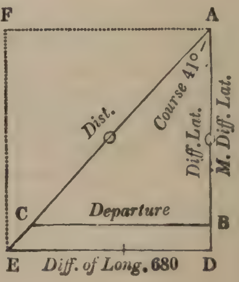
CASE VIII.

*One Latitude, Course, and Difference of Longitude given, to find the Distance and Difference of Latitude.**

Example. A ship from latitude 34° 29′ N. sails S. 41° W. till her difference of longitude is 680 miles: required her present latitude and distance sailed.

BY CONSTRUCTION.

Draw A D, and make A F perpendicular to it, and equal to the difference of longitude 680; draw F E parallel to A D, A E making an angle with A D equal to the course 41°, meeting F E in E, and E D parallel to F A; then A D will be the mer. diff. of latitude equal to 782; which subtracted from the mer. parts of the latitude left, gives the mer. parts of the latitude in: hence the latitude in is 23° 6′, and the diff. of latitude 683. Make A B equal to 683, and draw B C parallel to E D; then A C will be the distance measuring 905.



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* This Case cannot be solved by Middle Latitude Sailing.

BY CALCULATION.

To find the Mer. Diff. of Latitude.	
As radius	10.00000
Is to diff. of long. 680	2.83251
So is co. tang. course 41°	10.06084
	12.89335
	10 00000
To mer. diff. lat. 782.3	2.89335

Lat left	34° 29′N.	Mer. pts.	2207
		Mer. diff. lat.	782
Lat. in	23 6 N.	Mer. pts.	1425
Diff. lat.	11 23		
	60		
Miles	683		

To find the Distance.	
As co. sine course 41°	9.87778
Is to diff. of latitude 683...........	2.83442
So is radius	10.00000
	12.83442
	9.87778
To the distance 905	2.95664

EXAMPLES FOR EXERCISE.

1. Required the course and distance from the Cape of Good Hope, in latitude 34° 22′ S., and longitude 18° 24′ E., to the Island of St. Helena, in latitude 15° 55′ S., and longitude 5° 45′ W.

Answer. By Middle Latitude Sailing, the course is N. 49° 51′ W., and distance 1717 miles.*

By Mercator's Sailing, the course is N. 49° 40′ W., and distance 1710 miles.

2. Required the bearing and distance of Pernambuco, in latitude 8° 4′ S., and longitude 34° 53′ W., from Cape Verd, in latitude 14° 45′ N., and longitude 17° 32′ W.

Answer. By Middle Latitude Sailing, the course or bearing from Cape Verd to Pernambuco is S. 37° 12′ W., and the distance 1719 miles.

By Mercator's Sailing, the bearing is S. 37° 1′ W., and distance 1715 miles.

3. Required the course and distance from Cape Sierra Leone, in latitude 9° 30′ N., and longitude 13° 18′ W., to Cape St. Roque, in latitude 5° 28′ S., and longitude 35° 17′ W.

Answer. By Middle Latitude Sailing, the course is S. 55° 44′ W., and the distance 1595 miles.

By Mercator's Sailing, the course is S. 55° 40′ W., and distance 1592 miles.

4. Required the course and distance from Cape Palmas, in latitude 4° 24′ N., and longitude 7° 46′ W., to St. Paul de Loando, in latitude 8° 48′ S., and longitude 13° 8′ E.

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* If the true middle latitude were found by the proportion given in the note at the bottom of page 85 (25° 50′), the answer would be the same as that by Mercator's Sailing.

Answer. By Middle Latitude Sailing, the course is S. 57° 42′ E., and the distance 1482 miles.

By Mercator's Sailing, the course is S. 57° 40′ E., and distance 1481 miles.

5. A ship from latitude 29° 47′ N., and longitude 24° 36′ W., sails S. S. W. $\frac{3}{4}$ W. 320 leagues: required her present latitude and longitude.

Answer. By Middle Latitude Sailing, her latitude in is 16° 4′ N., and longitude in 33° 32′ W.

By Mercator's Sailing, her latitude in is 16° 4′ N., and longitude in 33° 33′ W.

6. A ship from latitude 2° 5′ N., and longitude 22° 30′ W., sails W. S. W. 256 leagues: required her present latitude and longitude; also her course and distance to St. Ann's Island, Maranham, in latitude 2° 15′ S., and longitude 43° 38′ W.

Answer. By Middle Latitude, or Mercator's Sailing, the latitude in is 2° 49′ S., longitude 34° 20′ W.; the course to St. Ann's Island N. 86° 31′ W., or W. $\frac{1}{4}$ N. nearly, and distance 559. 6 miles.

7. A ship from latitude 71° 20′ N., and longitude 28° 10′ E., sails E. S. E. until she arrives in the parallel of 70° N.: required her longitude in, with her direct course and distance to Cape Sweetnose, in latitude 68° 10′ N., and longitude 40° 3′ E.

Answer. By Middle Latitude Sailing, the longitude in is 37° 53′ E.; the course to Cape Sweetnose is S. 22° 53′ E. or S S. E., and the distance 119. 4 miles.

By Mercator's Sailing, the longitude in is 37° 54′ E.; the course to Cape Sweetnose is S. 22° 44′ E. or S. S. E., and the distance 119. 3 miles.

8. Suppose a ship from latitude 9° 10′ N., and longitude 19° 32′ W., sails in the South-east quarter till she has made 415 miles of departure, and is by observation in lat. 2° 19′ S.: required her course steered, distance run, and longitude in.

Answer. By Middle Latitude, or Mercator's Sailing, her course steered is S. 31° 4′ E., distance run 804. 2, and longitude in 12° 36′ W.

9. A ship from latitude 46° 35′ N., and longitude 176° 42′ W., sails N. W. by W. $\frac{1}{2}$ W. till she arrives in latitude 51° 18′ N.: required the distance run, and longitude in.

Answer. By Middle Latitude Sailing, her distance run is 600. 3 miles, and longitude in 169° 52′ E.

By Mercator's Sailing, her distance run is 600. 3 miles, and longitude in 169° 50′ E.

10. A ship from Table Bay (Cape of Good Hope), in latitude 33° 53′ S., and longitude 18° 19′ E., sails N. W. $\frac{3}{4}$ W. till she arrives in latitude 27° 32′ S.: required her course and distance to St. Helena, in latitude 15° 55′ S., and longitude 5° 45′ W.

Answer. By Middle Latitude Sailing, the longitude in is 8° 22′ E.; the course to St. Helena N. 48° 28′ W., and distance 1051 miles.

By Mercator's Sailing, the longitude in is 8° 22′ E.; the course to St. Helena N. 48° 24′ W., and distance 1050 miles.

OF COMPOUND COURSES.

To find the Difference of Longitude made good upon Compound Courses, by Middle Latitude and Mercator's Sailing.

In the preceding Cases, both of Middle Latitude and Mercator's Sailing, we have always supposed the ship to sail on a direct course; but when she makes a compound course, the several courses are to be reduced to a single course, as in Traverse Sailing, and then the difference of longitude may be found either by Middle Latitude or Mercator's Sailing, as will appear by the following

Example. Suppose a ship from latitude 52° 36′ N., and longitude 21° 45′ W., sails N. E. 36 miles; N. b. W. 14 miles; N. E. b. E. ½ E. 58 miles; N. b. E. 42 miles; and E. N. E. 29 miles: required her present latitude and longitude.

Courses.	Distance.	Difference of Lat.		Departure.	
		N.	S.	E.	W.
N. E.	36	25. 5		25. 5	
N. b. W.	14	13. 7			2. 7
N. E. b. E. ½ E.	58	27. 3		51. 2	
N. b. E.	42	41. 2		8. 2	
E. N. E.	29	11. 1		26. 8	
	Diff. of Lat.	118. 8		111. 7	2. 7
				2. 7	
			Dep.	109. 0	

The difference of latitude 118. 8, and departure 109. 0, give the course N. 42° 32′ E., and distance 161. 2, by Case VI. of Plane Sailing.

Latitude left	52° 36′ N.	Mer. pts.	3724	Longitude left	21° 45′ W.
Diff. lat. 119, or	1 59 N.			Diff. long. 184, or	3 4 E.
Latitude in	54 35 N.	Mer. pts.	3925	Longitude in	18 41 W
Sum of lats. 2)	107 11	Mer. diff. lat.	201		
Mid. latitude	53 35				

To find the Difference of Longitude.

By the Middle Latitude.		*By Mercator.*	
As co. sine mid. lat. 53° 35′	9. 77353	As co. sine course 42° 32′	9. 86740
Is to departure 109	2. 03743	Is to mer. diff. lat. 201	2. 30320
So is radius	10. 00000	So is sine course 42° 32′	9. 82996
	12. 03743		12. 13316
	9. 77353		9. 86740
To the diff. of long. 183. 6	2. 26390	To the diff. of long. 184. 4	2. 26576

BY INSPECTION.

The co. mid. latitude being about 36½°, first look for 36° as a course, and for the departure 109 in one of the dep. columns, against the nearest to which is 186 in a dist. column; then look for the departure 109 in the page with 37° at the top, opposite which stands 181 in a dist. column; the sum of this and 186 is 367, the half of which is 183. 5, the difference of longitude by Middle Lat. Sailing: or, the course being 42½°, look in the pages with 42° and 43° at the top for the mer. diff. of latitude 201 in a lat. column, against the nearest to which will be 181. 3 and 187. 5 in the corresponding dep. columns; the sum of these is 368. 8, half of which is 184. 4, the diff. of longitude by Mercator's Sailing.

The above method is that generally practised at sea in estimating the difference of longitude made good in a day's run, being considered sufficiently exact for the distance sailed by a ship in that time; but when the distances are considerable, especially in high latitudes, it is more accurate to estimate the difference of longitude made upon each course and distance, according to the following rules.

I. *By Middle Latitude.* To the Traverse Table annex a Longitude Table, divided into six columns; the first is to contain the latitude left, and the several latitudes the ship is in at the end of each course and distance, estimated by the latitudes left, and differences of latitude in the Traverse Table; the second, the sums of each following pair of latitudes; the third, half the sums of middle latitudes; the fourth, the complements of the middle latitude; and the fifth and sixth columns are to contain the differences of longitude. Having found the co. mid. latitudes, with these and their corresponding departures in the Traverse Table, find the differences of longitude, and place them in the east or west columns, according to the name of the departure; then the difference of the sums of these columns will be the difference of longitude made good, of the same name with the greater.

II. *By Mercator.* To the Traverse Table annex a Longitude Table, consisting of five columns; the first is to contain the latitude left, and the latitudes of the ship at the end of each course and distance; the second, the meridional parts corresponding to each latitude; the third, the meridional differences of latitude; and the fourth and fifth, the differences of longitude.

Having found the meridional differences of latitude, with these and the courses in the Traverse Table, find the corresponding differences of longitude, which place in the east or west columns, according as the course is easterly or westerly; then the difference between the sums of these columns will be the difference of longitude made good upon the whole Traverse, of the same name with the greater.

NOTE. When the course is north or south, there is no difference of longitude; and when it is east or west, the difference of longitude must be found, as in Case II. of Parallel Sailing.

The differences of longitude may be found by any of the methods given in the Sailings; but in the following Example we have used Inspection only

EXAMPLE.

A ship from Hangcliff, in latitude 60° 9′ N., and longitude 1° 7′ W., sailed as follows, *viz.* N.E. b. N. 69 miles; N.N.E. 48 miles; N. b. W. ½ W. 78 miles; N. E. 108 miles; and S. E. b. E. 50 miles: required her latitude and longitude in.

BY MIDDLE LATITUDE.

TRAVERSE TABLE.

Courses.	Dist.	Diff. Lat.		Departure.	
		N.	S.	E.	W.
N. E. b. N.	69	57.4		38.3	
N. N. E.	48	44.4		18.4	
N. b. W. ½ W.	78	74.6			22.6
N. E.	108	76.4		76.4	
S. E. b. E.	50		27.8	41.6	
		252.8	27.8	174.7	22.6
		27.8		22.6	
	D. lat.	225.0		152.1	Dep.

Course N. 34° E. and Distance 272 miles.

LONGITUDE TABLE.

Lats.	Sums.	Mid. Lats.	Co. Mid. Lats.	Diff. Long.	
				E.	W.
60° 9′					
61 6	121° 15′	60° 37′	29° 23′	78	
61 50	122 56	61 28	28 32	38	
63 5	124 55	62 27	27 33		49
64 21	127 26	63 43	26 17	174	
63 53	128 14	64 7	25 53	95	
Longitude left ...... 1° 7′ W.				385	49
Diff. long. 336, or 5 36 E.				49	
Longitude in... 4 29 E.				336	

BY MERCATOR.

TRAVERSE TABLE.

Course.	Dist.	Diff. Lat.		Departure.	
		N.	S.	E.	W.
N. E. b. N.	69	57.4		38.3	
N. N. E.	48	44.4		18.4	
N. b. W. ½ W.	78	74.6			22.6
N. E.	108	76.4		76.4	
S. E. b. E.	50		27.8	41.6	
		252.8	27.8	174.7	22.6
		27.8		22.6	
	D. lat.	225.0		152.1	Dep.

Course N. 34° E. and Distance 272 miles.

LONGITUDE TABLE.

Lats.	Mer. Parts.	Mer. D. Lats.	Diff. Long.	
			E.	W.
60° 9′	4545			
61 6	4662	117	78.3	
61 50	4754	92	38.3	
63 5	4916	162		49.1
64 21	5088	172	172.0	
63 53	5023	65	97.3	
Longitude left... 1° 7′ W.			385.9	49.1
Diff. long. 337, or 5 37 E.			49.1	
Longitude in... 4 30 E.			336.8	

The longitude of the ship, according to the first method, is 4° 17′ E. by Middle Latitude, and the same by Mercator's Sailing, differing from the above 12 and 13 miles; but as we have already observed, it is seldom necessary to use the latter methods at sea.

OBLIQUE SAILING.

OBLIQUE SAILING is the application of oblique-angled plane triangles to various cases at sea; as in coasting along shores, approaching or leaving the land, surveying coasts or harbours, &c.

In this kind of sailing, *to set an object*, means to observe what rhumb, or point of the compass, is directed to it; and the *bearing* of an object is the rhumb on which it is seen; also the bearing of one place from another, is reckoned by the name of the rhumb passing through those two places: hence the bearing of two places from each other are upon opposite points of the compass; thus, if one place bear E. N. E. from another, the latter will bear W. S. W. from the former, being in the same line, but in opposite directions.

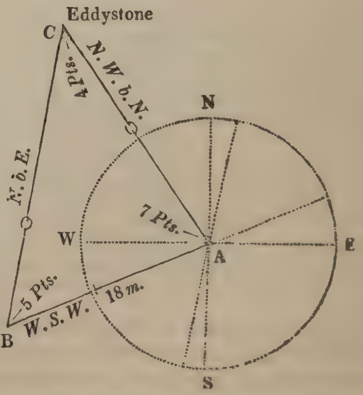
A great variety of Examples might be given in this Sailing; but as they would rather tend to exercise the learner in Trigonometry than answer any direct purpose, we shall select those only that appear to be useful in practice.

EXAMPLE I.

Sailing down the Channel, I observed the Eddystone bear N. W. b. N.; and after sailing W. S. W. 18 miles, I found it bore from me N. b. E.: required the distance of the ship from the Eddystone at both stations.

BY CONSTRUCTION.

Describe the circle N. W. S. E., to represent the compass, and draw the diameters W. E. and N. S. at right angles to each other; draw the N. W. b. N., W. S. W., and N. b. E. rhumb lines, and on the W. S. W. line lay off 18 from A to B, taken from any scale of equal parts; through B draw B C parallel to the N. b. E. line, meeting the N. W. b. N. line A C in C; then will A represent the place of the ship at her first station, B her place at the second station, and C the place of the Eddystone; A C will be the ship's distance from the Eddystone at the first station, measuring 21 miles, and B C the distance at the second station, measuring 25 miles



BY CALCULATION

In the triangle A B C are given the side A B 18 miles, the angle C A B equal to 7 points, the measure of the arch contained between the N. W. b. N and the W. S. W. lines; the angle A B C equal to 5 points, the interval between the N. b. E. and the E. N. E. line (being the opposite to the W. S. W. rhumb); and the angle B C A equal to 4 points, the interval between the S. b. W. and the S. E. b. S. lines; to find the sides A C and B C.

To find the Side A C.

As sine of angle C 4 points	9.84949
Is to the side A B 18	1.25527
So is sine angle B 5 points	9.91985
	11.17512
	9.84949
To the side A C 21.17	1.32563

To find the Side B C.

As sine of angle C 4 points	9.84949
Is to the side A B 18	1.25527
So is sine angle A 7 points	9.99157
	11.24684
	9.84949
To the side B C 24.97	1.39735

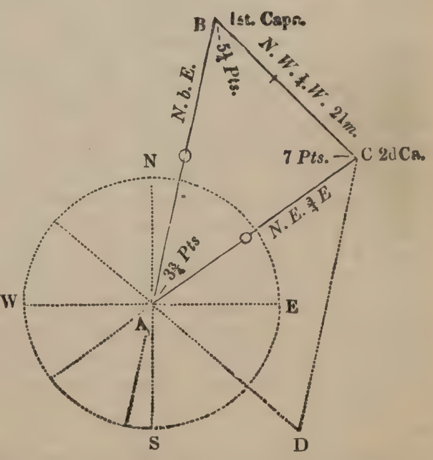
Hence the distance of the Eddystone from the ship's first station is 21.17 miles, and from the second station 24.97, or 25 miles nearly.

EXAMPLE II.

Coasting along shore, I observed two Capes: the first bore N. b. E., and at the same time the second bore N. E. ¾ E.; now, by the Chart, these Capes bear from each other N. W. ¼ W., and S. E. ¼ E. (by compass), distant 21 miles: required my distance from both places at that time.

BY CONSTRUCTION.

Having drawn the compass N. W. S. E., the centre of which is to represent the ship's place, draw the N. b. E. and N. E. ¾ E. rhumb lines A B and A C, being the bearings of the Capes from the ship; draw likewise the N. W. ¼ W and S. E. ¼ E. line, the bearing of the Capes from each other, on which from A to D lay off 21 miles, the distance between the Capes; through D draw D C parallel to the N. b. E. line, and through C draw C B parallel to the N. W. ¼ W. and S. E. ¼ E. line; then B will represent the place of the first Cape, C the second Cape, A B the distance of the first Cape from the ship, measuring 31 miles, and A C the distance of the second Cape, measuring 27 miles.



BY CALCULATION.

In the triangle A B C are given the angle B A C $3\frac{3}{4}$ points, the arch between the N. b. E. and N. E. $\frac{3}{4}$ E. lines; the angle A B C $5\frac{1}{4}$ points, the interval between the S. b. W. and S. E. $\frac{1}{4}$ E. lines; and the angle A C B 7 points, the interval between the N. W. $\frac{1}{4}$ W. and S. W. $\frac{3}{4}$ W. lines; and the side B C 21 miles; to find the sides A B and A C.

To find the Side A B.

As sine angle A $3\frac{3}{4}$ points	9. 82708
Is to the side B C 21	1. 32222
So is sine angle C 7 points	9. 99157
	11. 31379
	9. 82708
To the side A B 30. 67	1. 48671

To find the Side A C.

As sine angle A $3\frac{3}{4}$ points	9. 82708
Is to the side B C 21	1. 32222
So is sine angle B $5\frac{1}{4}$ points	9. 93335
	11. 25557
	9. 82708
To the side A C 26. 82	1. 42849

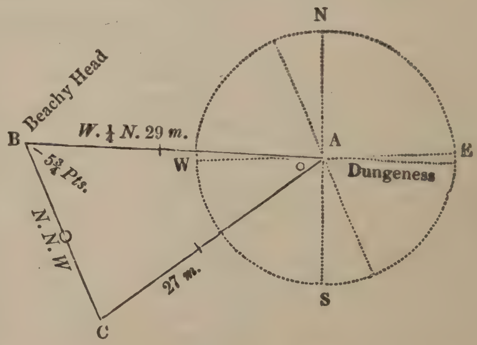
Hence the distance of the ship from the first Cape is 30. 67 miles, and from the second Cape 26. 82, or 27 miles nearly.

EXAMPLE III.

Being close in with Dungeness, I ran 27 miles on a direct course to the westward, and then found Beachy Head bear N. N. W.; now the bearing of Beachy Head from Dungeness (by compass) is W. $\frac{1}{4}$ N., and the distance 29 miles: required the course steered, and the distance of the ship from Beachy Head.

BY CONSTRUCTION.

Describe a circle, and divide it into 4 equal parts by the diameters N. S. and W. E., the extremes of which will represent the cardinal points of the compass; and the centre of the circle the place the ship sailed from (Dungeness); draw the W. $\frac{1}{4}$ N. line A B equal to 29 miles, then will B represent the place of Beachy Head: through B draw B C parallel to the N. N. W. line, and with the distance run, 27 miles in the compasses, set one foot in A, and with the other describe an arch cutting B C in C, and draw the line A C: then will C represent the ship's place, B C the distance of the ship from Beachy Head, measuring 19 miles, and the angle S A C the course steered from the south, measuring 53°39′



BY CALCULATION.

In the triangle A B C are given the side A B, equal to 29 miles; the side A C 27 miles; and the angle A B C $5\frac{3}{4}$ points, the interval between E. $\frac{1}{4}$ S. and S. S E.; to find the angle B A C, and the side B C

To find the Angle B A C.

As the side A C 27	1. 43136
Is to sine of angle A B C 5¾ points	9. 95616
So is the side A B 29	1. 46240
	11. 41856
	1. 43136
To sine of angle B C A 76° 9′[*]	9. 98720

Angle B C A	76°	9′
Angle A B C 5¾ pts. or	64	41
Sum	140	50
	180	00
Angle B A C	39	10

To find the Side B C.

As sine of angle A B C 5¾ points...	9. 95616
Is to the side A C 27	1. 43136
So is sine of angle B A C 39° 10′...	9. 80043
	11. 23179
	9. 95616
To the side B C 18. 86	1. 27563

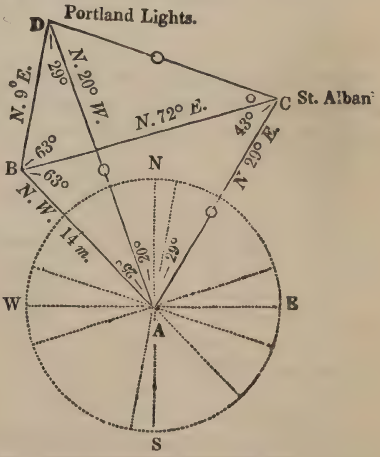
Now the bearing of A B, which is W. ¼ N. or W. 2° 49′ N., subtracted from the angle B A C 39° 10′, gives the bearing of A C W. 36° 21′ S.; hence the course steered is S. 53° 39′ W. or S. W. ¾ W., and the distance of the ship from Beachy Head is 18. 86, or 19 miles nearly.

EXAMPLE IV.

At noon St. Alban's Head bore N. 29° E., and Portland Lights N. 20° W.; and running N. W., at the rate of 7 knots an hour, at 2 P. M. St. Alban's Head bore N. 72° E., and Portland Lights N. 9° E.: required the bearing and distance of Portland Lights from St. Alban's Head.

BY CONSTRUCTION.

Draw the compass as before, and let the centre A represent the first station, from which draw the first bearing A C, N. 29° E., and the second bearing A D, N. 20° W.; also draw the N. W. line A B equal to 14 miles, the distance run in 2 hours; then will B represent the second station; through B draw B C parallel to N. 72° E., and B D parallel to N. 9° E., meeting the lines A C and A D in C and D, and join D C; then will C represent St. Alban's Head, D Portland Lights, and C D their distance, measuring 18. 29 miles, the bearing of which will be N. 70½° W., or W. N. W. ¼ W.



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[*] If the above angle B C A be considered obtuse, or 103° 51′, the side B C would then be 5. 938. (See Rules, page 45).

BY CALCULATION.

In the triangle A B C are given the side A B 14 miles, the angle A C B equal to 43°, the interval between S. 72° W. and S. 29° W.; and the angle A B C equal to 63°, the interval between N. 72° E., or E. 18° N. and S. E., or S. E. 45° S.; to find the side A C.

As sine of angle A C B 43°	9. 83378
Is to the side A B 14	1. 14613
So is sine of angle A B C 63°	9. 94988
	11. 09601
	9. 83378
To the side A C 18. 29	1. 26223

In the triangle A B D are given the side A B 14 miles, the angle A D B equal to 29°, the interval between S. 20° E. and S. 9° W.; the angle A B D equal to 126°, the interval between N. 9° E., or E. 81° N., and S. E. or S. 45° E.; to find the side A D.

As sine of angle A D B 29°............	9. 68557
Is to the side A B 14m.	1. 14613
So is sine of angle A B D 126°	9. 90796
	11. 05409
	9. 68557
To the side A D 23. 36	1. 36852

In the triangle A C D are given the side A C 18. 29; the side A D 23. 36; and the included angle C A D equal to 49°, the interval between N. 29° E. and N. 20° W.; to find the angle A C D, and the side C D.

To find the Angle A C D.

Side A D	23. 36	
Side A C	18. 29	
Sum	41. 65	
Difference	5. 07	
		180
Angle C A D		49
Sum of A D C & D C A		131
Half		65 30′

As sum of the sides A C, A D, 41. 65		1. 61962
Is to their difference 5. 07		0. 70501
So is tang. of half the sum of angles A D C, D C A	65° 30′	10. 34130
		11. 04631
		1. 61962
To tang. of half their diff.	14 57	9. 42669
Sum gives the angle A C D	80 27	

To find the Side C D.

As sine of angle A C D 80° 27′	9.99394
Is to the side A D 23.36	1.36847
So is sine of angle C A D 49°	9.87778
	11.24625
	9.99394
To the side C D 17.88	1.25231

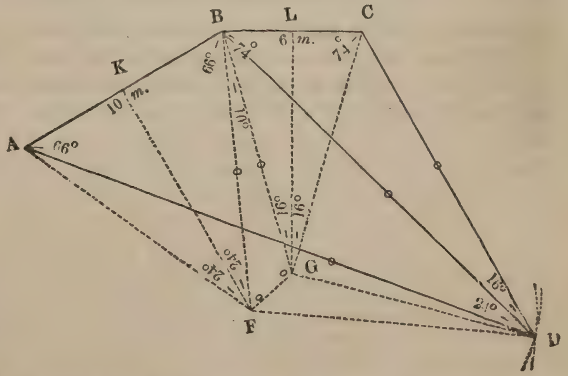
Now the angle A C D 80° 27′ added to 29°, the bearing of A C from the south, gives the bearing of C D, S. 109° 27′ W., which, subtracted from 180°, leaves the bearing N. 70° 33′ W. or W. N. W. ¼ W. nearly: hence the bearing of Portland Lights from St. Alban's Head is W. N. W. ¼ W (by compass), and the distance 18 miles nearly.

NOTE. In this manner the mutual bearings and distances of any number of points may be ascertained; but in practice it is more expeditious, and in general sufficiently exact, to construct the figure on a proper scale, and then measure off the several parts.

EXAMPLE V.

Coasting along shore, I struck upon a shoal, and wanting to ascertain its situation exactly, I took angles with my sextant, subtended by three objects on shore, as A, B, and C, whose relative positions were as follow: the distance from A to B was 10 miles, from B to C 6 miles, and the angle A B C 150°; now the angle, measured at the ship, between A and B, was 24°, and between B and C 16°: required the distance of D, the ship's place, from each object.

BY CONSTRUCTION.



Draw the line A B, and make it equal to 10; at B make the angle A B C 150°, and draw the line B C equal to 6.

Bisect the line A B (Problem I. Geom.), and draw the line K F, which will be perpendicular to A B; make the angles F A B and F B A each equal to 66° (the complement of the given angle A D B 24°), and draw the lines A F, B F, meeting at F; then, the triangles A K F and B K F being right-angled at K, the angles A F K and B F K will be each equal to 24°, and the angle A F B at K 48°, or double the given angle A D B.

In like manner bisect the line B C, and draw the line L G; make the angles G B C and G C B each equal to 74° (the complement of the given angle B D C 16°), and draw the lines B G, C G, meeting at G; then will the angle B G C be 32°, or double the angle B D C.

With the radius A F, or B F, from F, draw an arch at D.

With the radius G B, or G C, from G draw an arch, cutting the former one at the point D,* which will be the ship's place.

Draw the lines C D, B D, and A D, which will be the distances required; that is C D will measure 15. 17, B D 18. 88, and A D 23. 66, the angle A D B measuring 24°, and the angle B D C 16°.†

Draw the lines F G, F D, and G D.

BY CALCULATION.

In the isoceles triangle A F B are given the side A B 10, the angles A F B 48°, and F A B 66°, to find the side F B 12. 29, equal to the sides F A or F D.

Or, in the right-angled triangle B K F are given the side B K 5 (the half of A B), and the angle B F K 24°, to find the side B F 12. 29, equal to the sides F A or F D.

In the isoceles triangle B G C are given the side B C 6, the angles G B C 74°, and B G C 32°, to find the side G B 10. 88, equal to the sides G C or G D.

Or, in the right-angled triangle B L G are given the side B L 3 (the half of B C), and the angle B G L 16°, to find the side G B 10. 88, equal to the sides G C or G D.

The angle A B F 66°, added to the angle G B C 74°, and their sum 140°, subtracted from the angle A B C 150°, the remainder will be the angle F B G 10°.

In the triangle F B G are given the side F B 12. 29, the side G B 10. 88, and the angle F B G 10°, to find the angles B F G 50° 11′, and B G F 119° 49′.

The triangles F B G and F D G are *identical*, that is, mutually equal in all their parts; the side F B being equal to the side F D 12. 29, G B to G D 10. 88, and F G common to both triangles; therefore, the angle B F G is equal to the angle G F D 50° 11′, F G B to F G D 119° 49′, and F B G to F D G 10°.

The angle B F G 50° 11′, added to the angle G F D 50° 11′, their sum will be the angle B F D 100° 22′.

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* When the arches at D intersect each other at very acute angles (as in the present example), it will be difficult to determine exactly the point of intersection; the point D may in such case be found, independent of the arches, as follows:—From B let fall a perpendicular on F G, produced if necessary, and draw the line B D of an indefinite length; then produce the lines B F and B G to twice their lengths; through the ends of these lines draw a line meeting the line B D, and it will intersect it at the point D.

† In Euclid, Book III., Prop. XX., it is demonstrated that "the angle at the centre of a circle is double the angle at the circumference upon the same base, that is, upon the same part of the circumference;" therefore, the angle A D B is half the angle A F B, and the angle B D C is half the angle B G C.

In the isoceles triangle B F D, the angle B F D 100° 22′, subtracted from 180° (the sum of the three angles), will give the remainder 79° 38′, the half of which, 39° 49′, will be the angle F B D or F D B.

In the isoceles triangle B F D are given the sides F B and F D 12. 29, the angle B F D 100° 22′, and the angle F B D or F D B 39° 49′, to find the side B D 18. 88.

The angle F B D 39° 49′, added to the angle F B A 66°, their sum will be the angle A B D 105° 49′.

In the triangle A B D are given the side A B 10, the angle A B D 105° 49′, and the angle A D B 24°, to find the side A D 23. 66.

The angle A B D 105° 49′, subtracted from the angle A B C 150°, the remainder will be the angle C B D 44° 11′.

In the triangle B D C are given the side B C 6, the angle C D B 16°, and the angle C B D 44° 11′, to find the side C D 15. 17.

Hence the distance of the ship at D from A is 23. 66 miles, from B 18. 88 miles, and from C 15. 17 miles.

NOTE. The learner is left to work the proportions by the Rules in Trigonometry, the answers to which are given above; but, as observed in the last example, it will in general be sufficiently exact to construct the figure, and measure off the distances required.

In this manner rocks, buoys, shoals, or soundings may be accurately laid down on adjacent coasts, when the relative positions of three stations on shore are ascertained.

EXAMPLES FOR EXERCISE.

1. Running down Channel, and wanting to take my departure from the Lizard, at 2 h. P. M. I observed it bear from me N. b. W.; and after sailing W. b. N. ¼ N., at the rate of 8 knots per hour, at 3 h. 30 m. P. M. it bore from me N. N. E. ½ E.: required my distance from the Lizard at the time of taking the second bearing.

Answer. The distance 17. 1 miles.

2. Entering the River Thames by night, I observed Orfordness Lights bear from me N. b. E. ¼ E., and the Sunk Light W. ¼ S., the former bearing from the latter N. E. b. N. ¼ E., distant 18 miles: required my distance from each of the Lights.

Answer. Distance from Orfordness Lights 14. 54 miles, and from the Sunk Light 7. 198 miles.

3. Being off the Burlings (on the Coast of Portugal), I ran 34 miles on a direct course between the south and west, and then observed the Rock of Lisbon bearing from me S. by E. ½ E., the Rock bearing from the Burlings S. b. W. ¾ W. (by compass), and their distance being 43 miles: required the course steered, and my distance from the Rock.

Answer. The ship's course was S. 32° W. or S. S. W. ¾ W. nearly, and my distance from the Rock 12. 17 miles.

4. Sailing between two small islands, I observed the first bear from me S. W. b. W. $\frac{3}{4}$ W., and the second E. S. E.; after running S. b. W. $\frac{1}{2}$ W 15 miles, the first bore from me N. W. b. W., and the second E. $\frac{1}{2}$ N. required the bearings, and distance between the islands.

Answer. The first island bore from the second N. 84° 28′ W., the second from the first S. 84° 28′ E., and their distance was 42. 49 miles.

5. Two ships, A and B, sail from the same port C; A sails N. E. b. N. 84 miles, and B sails S. E. 76 miles: required their bearings, and distance from each other.

Answer. Bearing of A from B N. 3° 16$\frac{1}{2}$′ W., of B from A S. 3° 16$\frac{1}{2}$′ E., and their distance 123. 8 miles.

6. Being off the Coast of South America, in latitude 47° 4′ 30″ S., and longitude 65° 26′ W., I found the (true) bearing of Cape Blanco to be W. 20° S., and after running S. 12° 30′ W. 32 miles, the Cape bore N. 34° W.: required the latitude and longitude of the Cape.

Answer. The latitude of Cape Blanco is 47° 12′ 42″ S., and longitude 65° 59′ W.

7. Wanting to know the distance of a ship at anchor from the shore, I chose two stations, A and B, that were distant from each other 2. 5 miles. From the station at A, I took with a sextant the angle subtended by the station at B and the ship, and found it to be 64° 15′; then from the station at B, I found the angle between the station A and the ship, 73° 55′: required the distance of the ship from both stations.

Answer. The distance of the ship from the station at A was 3. 602, and from the station at B, 3. 376 miles.

8. Sailing along a coast, I observed two objects, a church and a mill, in one, the church being the nearer object; and at the same time I measured the angle subtended at the ship by the church and a tower on the coast, and found it to be 25° 36′; now, by a chart, the distance from the church to the tower was 1. 5 mile, from the church to the mill . 75 of a mile, and from the mill to the tower 1. 9 mile: required the distance of the ship from the church and the tower.

Answer. The distance of the ship from the church was 3. 459 miles, and from the tower 3. 246 miles.

9. From Winterton Lighthouse to Hasborough High Lighthouse the bearing and distance are N. 41° 40′ W. 8. 54 miles, and from the latter to Cromer Lighthouse N. 51° 6′ W. 9. 64 miles; from Hasborough Light-vessel, the angle between Winterton and Hasborough Lighthouses, measured by a sextant, was 28° 35′, and between the latter and Cromer Light 59° 8′: required the bearings and distances from the light-vessel to the three above-mentioned lighthouses.

Answer. From Hasborough Light-vessel to Cromer Lighthouse the bearing and distance are S. 76° 7′ W. 10.42 miles; from the same to Hasborough Lighthouse, S. 16° 59′ W. 8. 943 miles; and from the same to Winterton Lighthouse, S. 11° 36′ E. 15. 24 miles.

Note. The above is worked similar to Example V., page 117

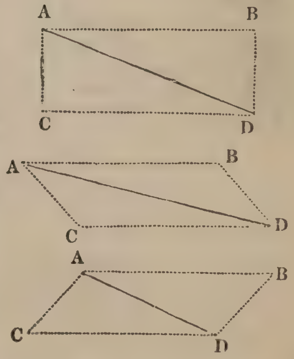
CURRENT SAILING

CURRENT SAILING is the method of determining the true course and distance of a ship, when her own motion is affected and combined with that of a current.

A Current is a progressive motion of the water, causing all floating bodies to move that way towards which the stream is directed. The *setting of a current* is that point of the compass towards which the water runs; and its *drift* is the rate at which it runs per hour, or in any other given time.

The most usual method of ascertaining the set and drift of an unknown current is to take a boat, in calm weather, a small distance from the ship, and, being provided with a half-minute glass, a log, a heavy iron pot, or some heavy piece of metal, and a small boat-compass, to let down the pot, or weight, by a rope fastened to the boat's stem, to the depth of about 100 fathoms, by which the boat will remain nearly as steady as at anchor; then the log being hove, its bearing will be the setting of the current, and the number of knots run out in half-a-minute will be its drift per hour.

The current being known, it remains to apply its effects on a ship's way, which will depend on the direction and velocity of both, with regard to each other. If a ship sail in the direction of the current, it is evident that the velocity of the current must be added to that of the vessel; if her course be directly against the current, their difference will be the ship's true velocity; but if a ship's course be oblique to the current, her direction by the compass will be compounded with that of the current; that is, she will proceed in the diagonal of the parallelogram formed according to the two lines of direction, and will describe, or pass over, that diagonal in the same time in which she would have described either of the sides by the separate velocities. For let A B C D be a parallelogram, the diagonal of which is A D Now if the wind alone would drive the ship from A to B, in the same time the current alone would drive it from A to C, then as the wind neither helps nor hinders the ship from coming towards the line C D, the current will bring it there in the same time as if the wind did not act; and as the current neither helps nor hinders the ship from coming towards the line B D, the wind will bring it there in the same time as if the current did not act. Therefore, the ship must, at the end of that time, be found in both those lines, that is, in their meeting D: consequently, the ship must have passed from A to D in the diagonal line A D. Hence the ship's true distance will be the third side of a triangle, whereof the other sides are the distance by the log and the drift of the current, and the true course will be the angle between that third side and the meridian.

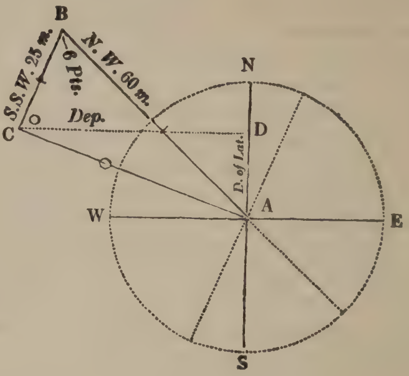


EXAMPLE I.

A ship sails N. W. 60 miles, in a current that sets S. S. W 25 miles in the same time: required her course and distance made good

BY CONSTRUCTION.

Having drawn the compass, set off 4 points from the North towards the West, and draw the N. W. line A B, which make equal to 60 miles, the distance run by the log; through B draw B C parallel to the S. S. W. and N. N. E. line, and equal to 25 miles, the set and drift of the current: now A C being joined, will be the true distance, measuring 55. 48 miles, and the angle N A C the true course N. 69° 36′ W



BY CALCULATION.

In the triangle A B C are given the side A B 60, the side B C 25, and the included angle A B C 6 points, or 67° 30′, to find the angle B A C and the side A C.

To find the Angle B A C.

Side A B... 60
Side B C... 25
Sum 85
Difference 35

180° 00′
Angle B 67 30
Sum of ang. A & C 112 30
Half 56 15

As the sum of A B, B C 85		1. 92942
Is to their difference 35		1. 54407
So is tang. of half the sum of angles A and C	56° 15′	10. 17511
		11. 71948
		1. 92942
To tang. of half the diff. ...	31 39	9. 78976
Diff. gives angle B A C......	24 36	
Angle N A B	45 0	
Sum gives the angle N A C	69 36	

To find the Side A C.

As sine of angle A 24° 36′............	9. 61939
Is to the side B C 25m.	1. 39794
So is sine of angle B 67° 30′.........	9. 96562
	11. 36356
	9. 61939
To the side A C 55. 48	1. 74417

Hence the course made good, N A C, is N. 69° 36′ W. or W. N. W. ¼ W nearly, and the distance A C 55 miles and a half.

But the most usual, and the easiest way of allowing for the effects of a current, is to consider the setting and drift as a course and distance, and enter it accordingly in a Traverse Table; then the whole difference of latitude and departure will give the true course and distance. By this method the preceding example is thus worked:

Courses.	Distance.	Difference of Lat.		Departure.	
		N.	S.	E.	W.
N. W.	60	42. 4			42. 4
S. S. W.	25		23. 1		9. 6
(Current.)					
		23. 1			
	Diff. of Lat.	19. 3		Dep.	52. 0

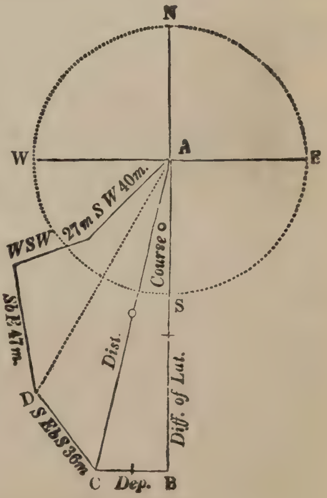
The difference of latitude A D 19. 3, and the departure C D 52, give the course D A C, N. 69° 38′ W., and the distance A C 55. 46, by Case VI. in Plane Sailing.

EXAMPLE II.

Suppose a ship in 24 hours sail as follows: S. W. 40 miles, W S. W. 27 miles, and S. by E. 47 miles, being all that time in a current setting S. E. b. S., at the rate of 1½ mile per hour: required her direct course, and distance made good.

BY CONSTRUCTION.

Draw the compass, and lay off the several courses and distances, as in Traverse Sailing; then will D represent the place of the ship by the log: from D draw D C parallel to the S. E. by S. line, and equal to 36 miles, for the setting and drift of the current in 24 hours; then will C be the ship's true place, the angle B A C the true course, measuring 11° 50′, A C the distance 117, A B the difference of latitude 114. 6, and B C the departure 24 miles.



BY CALCULATION.

With the several courses and distances by the log, the direct course D A S and distance A D may be found; then, in the triangle A D C will be given the angle A D C, and the sides A D, D C, to find the angle D A C, which subtracted from D A S, will give the true course S A C, and the side A C the true distance. But the solution of this triangle we shall leave to the learner, and work the question, by allowing for the set and drift of the current in the Traverse Table.

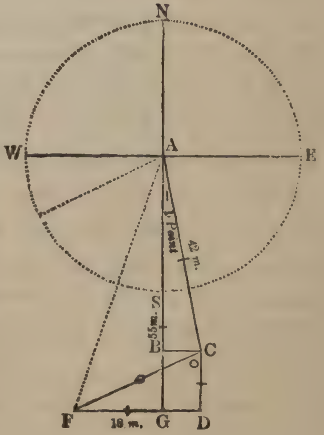
Courses.	Distance.	Difference of Lat.		Departure.	
		N.	S.	E.	W.
S. W.	40		28. 3		28. 3
W. S. W.	27		10. 3		24. 9
S. b. E.	47		46. 1	9. 2	
S. E. b. S.	36		29. 9	20. 0	
(Current.)					
		Diff. lat.	114. 6	29. 2	53. 2 29. 2
				Dep.	24. 0

The difference of latitude A B 114. 6, and the departure B C 24. 0, give the true course C A B S. 11° 50′ W., or S. b. W., and the distance A C 117. 1 miles, by Case VI. in Plane Sailing.

EXAMPLE III.

A ship sailing in a current has, by her Reckoning, run S. b. E. 42 miles but by Observations, finds she has made 55 miles of southing, and 18 miles of westing: required the set and drift of the current.

BY CONSTRUCTION.



Having drawn the compass, set off 1 point from the South towards the East, and draw the S. b. E. line A C, which make equal to 42 miles; through C draw the line C B parallel to the East and West, then will A B be the difference of latitude 41. 19, and B C the departure 8. 19, made by the log.

From A to G lay off 55, the diff. of lat. by Observation, and through G draw a line parallel to the East and West; from G towards F lay off 18, the true departure, and draw the line C F. From C draw a line parallel to A G, meeting the line F G produced, in D: then the angle F C D will be the setting of the current, measuring S. 62° 12′ W.; and the side C F the drift, 29. 59 miles.

BY CALCULATION.

In the triangle A B C are given the course B A C 1 point, and the distance A C 42 miles, to find the difference of latitude A B 41. 19, and the departure B C 8. 19.

Subtract A B 41. 19 S., the difference of latitude by the log, from A G 55 S., the difference of latitude by observation; and the remainder B G 13. 81 will be what the ship is to the southward of her reckoning.

To the departure B C (equal to G D) 8. 19 E., add the departure F G 18 W., and the sum F D 26. 19 will be what the ship is to the westward of her account.

The difference of latitude C D (equal to B G) 13. 81, and the departure D F 26. 19, give the angle or course S. 62° 12′ W., and the side C F, or distance 29. 59, for the setting and drift of the current.

EXAMPLES FOR EXERCISE.

1. A ship sails by her log N. W. b. N. 72 miles, in a current that sets W. N. W. 36 miles in the same time: required her course and distance, corrected for the effect of the current.

Answer. The course made good is N. 44° 51′ W., or N. W. nearly, and distance 104 miles.

2. A ship sails E. b. N. 7. 5 knots an hour, in a current setting S. W. 4 knots an hour: what will be her course and distance made good in 24 hours?

Answer. The course will be S. 73° 12′ E., or E. S. E. ½ E. nearly, and the distance 113. 5 miles.

3. A ship sailing at the rate of 9 knots an hour, and wanting to double a Cape bearing from her N. W. b. W., finds she is in a current setting S. S. W. 3½ miles an hour: what course must she steer to counteract the effect of the current?

Answer. The course she must steer for the Cape is N. 33° 50′ W., or N. W. by N. nearly.

4. A ship sailing by her log 9 miles an hour, is bound to a port which lies N. W. b. N. from her, distant 56 miles, and finds she is in a current setting N. E. ½ N. 3 miles an hour: what course must she steer in the current, and distance make good, and how long will it take her, to arrive at her port?

Answer. The course to be steered is N. 51° 21′ W., or N. W. ¾ W. nrly.; the distance to run 53. 61 miles, and the time it will take, nearly 6 hours.

5. A ship bound from Bombay to England, being on the edge of the Bank of Agulhas on April 21st, at noon, was, by Observation, in latitude 35° 3′ S., and in longitude, by Chronometer, 26° 52′ E.; on the 22d, the latitude, by Observation at noon, was 35° 13′ S., and the longitude, by Chronometer, 25° 5′ E.; having sailed by her Reckoning N. 81° W. 39 miles: required the set and drift of the current.

Answer. The current set S. 71° 49′ W., or W. 18° 11′ S., and its drift in 24 hours was 51. 57 miles, being at the rate of 2. 15 per hour.

DESCRIPTION AND USE OF CHARTS.

CHARTS are marine Maps, representing the whole or part of the surface of the water, and adjoining coasts; and exhibiting isles, rocks, shoals, banks, depths of water, rhumb-lines, and whatever other particulars may serve to direct the mariner on his voyage, or point out the dangers to be avoided: they are principally of two kinds, *Plane* and *Mercator's*.

OF PLANE CHARTS.

A Plane Chart is constructed on the supposition that the surface of the earth is an extended plane, the meridians all parallel strait lines, and the parallels of latitude at equal distances, and consequently that the lengths of the degrees of latitude and longitude are every where equal. But as the earth is spherical, and the meridians meet at the Poles, it is evident that charts constructed on this principle must be erroneous; for in them the difference of longitude, or distance between two meridians at the equator, is considered as the meridian distance in all latitudes. Hence, the position of places laid down on these charts, according to their latitudes and longitudes, will vary more or less from the truth, both in bearing and distance. However, where the chart extends but a few degrees on either side of the equator, the error will be trifling; because near the equator the meridians are nearly parallel to each other; or if it begin at any considerable distance from the equator, and extend only a few degrees of latitude, the error may in a great measure be obviated, by making the length of the degree of longitude equal to the co. sine of the mean latitude, one degree, or 60 miles, being radius. These charts, from their erroneous principles, being of little or no use in the practice of Navigation, have been totally rejected since the introduction of Mercator's projection.

Plane Charts, which are constructed on the assumption that small portions of the earth's surface are planes, are called COASTING CHARTS: in these neither latitudes nor longitudes are in general taken into consideration. They are usually drawn on a large scale, for the direction of mariners when near the land; and will not deviate much from the truth, either in bearing or distance, when they do not comprehend any great extent of coast.

In these charts places are laid down according to their bearing and distance from each other. The configuration of the coast, and other particulars, are taken from the best surveys, or such information as can be most depended upon.

OF MERCATOR'S CHARTS.

Mercator's Charts are constructed on the supposition that the earth is spherical. In these charts the meridians and parallels are strait lines, at right angles to each other; but the distances between the parallels are increased towards the Poles, in order to compensate for the expansion of the meridian distances, by which indeed those Countries situated far from the equator become distorted, or considerably enlarged beyond their relative size, with respect to those nearer the equator; notwithstanding which, the bearings and distances of places may be easily and accurately found by these charts.

The following is the method of constructing a chart on Mercator s projection.

Having first determined the limits of the proposed chart, that is, the number of degrees and minutes it is to contain, both of latitude and longitude, and the degree of each it is to commence from, take out the meridional parts from Table III., corresponding to each degree of latitude within the intended limits, and find the difference between the meridional parts of each succeeding latitude; but if the scale of the chart be small, the meridional parts, with their differences to every fifth or tenth degree, may be taken. Reduce the difference of the meridional parts into degrees, by dividing them by 60. Draw a line near one of the margins of the paper, to represent the parallel of the least latitude, on which lay off the proposed number of degrees of longitude, taken from a scale of equal parts, and number them at every fifth or tenth degree. From each end of this parallel draw perpendicular lines for the extreme meridians, and make them equal to the difference of the meridional parts of the extreme latitudes, taken from the scale of longitude, or graduated parallel; join the ends of these meridians by a strait line, which will represent the other extreme parallel, and is to be divided in the same manner as the first parallel.

Take the meridional difference of latitude between the least latitude and the next fifth or tenth degree of latitude, from the divided parallel, and lay it off from the first parallel on each of the extreme meridians. In like manner, the meridional difference of latitude between each successive five or ten degrees is to be taken from the graduated parallel, and laid off and numbered on the meridians; but if the chart be drawn on a large scale, the meridional differences of latitude between each degree are to be laid off. The spaces are then to be subdivided into degrees or miles.

Through each fifth or tenth degree of latitude and longitude draw meridians and parallels; or through each degree, if the scale will permit, without crowding the chart with a multiplicity of lines.

The principal points in the charts are now to be laid down according to their respective latitudes and longitudes, and connected either by observations made on the coast, agreeably to the directions given for surveying coasts and harbours, or from the best charts.

One or more compasses are to be inserted in the most convenient parts of the chart, and the rhumb-lines extended to the coast. The variation of the compass is to be set down in places where it is well ascertained. Currents are to be denoted by darts. The best anchorages, soundings, times of high water, &c. are all to be marked in their proper places. For further particulars, see *Maritime Surveying*.

In order to illustrate the above Rules, let us take an Example. Suppose, for instance, it be required to draw a chart extending from 2 degrees of east longitude to 30 degrees of west longitude, and from 10 degrees to 57 degrees of north latitude. (See Plate IV.)

Having drawn the bottom marginal line to represent the parallel of 10 degrees, divide it into 32 equal parts, the number of degrees of longitude the chart is to contain; and at each end erect a perpendicular line.

Take out the meridional parts corresponding to every fifth degree, and set them down with their differences in the following order:

Latitudes.	Merid. Parts.	Differences.			
10°	603				
		307	=	5°	7′
15	910				
		315	=	5	15
20	1225				
		325	=	5	25
25	1550				
		338	=	5	38
30	1888				
		356	=	5	56
35	2244				
		379	=	6	19
40	2623				
		407	=	6	47
45	3030				
		444	=	7	24
50	3474				
		494	=	8	14
55	3968				
		215	=	3	35
57	4183				

Now take the first difference 5° 7′ in the compasses from the divided parallel, and lay it off on both meridians from 10° to 15°; from 15° to 20° lay off the next difference 5° 15′, taken from the same parallel, and so proceed to the latitude 57°; through each of these corresponding points draw lines, to represent the respective parallels of latitude, and subdivide the extreme meridians into degrees. Divide the parallel of 57° in the same manner as that of 10°, and draw meridian lines through every fifth degree, numbering them as on the chart.

The principal points are to be laid down agreeably to their latitudes and longitudes, through which the coast is to be drawn; and the various particulars are to be inserted, as rocks, shoals, islands, a compass, &c. which will be best understood by inspecting the chart.

USE OF MERCATOR'S CHART.

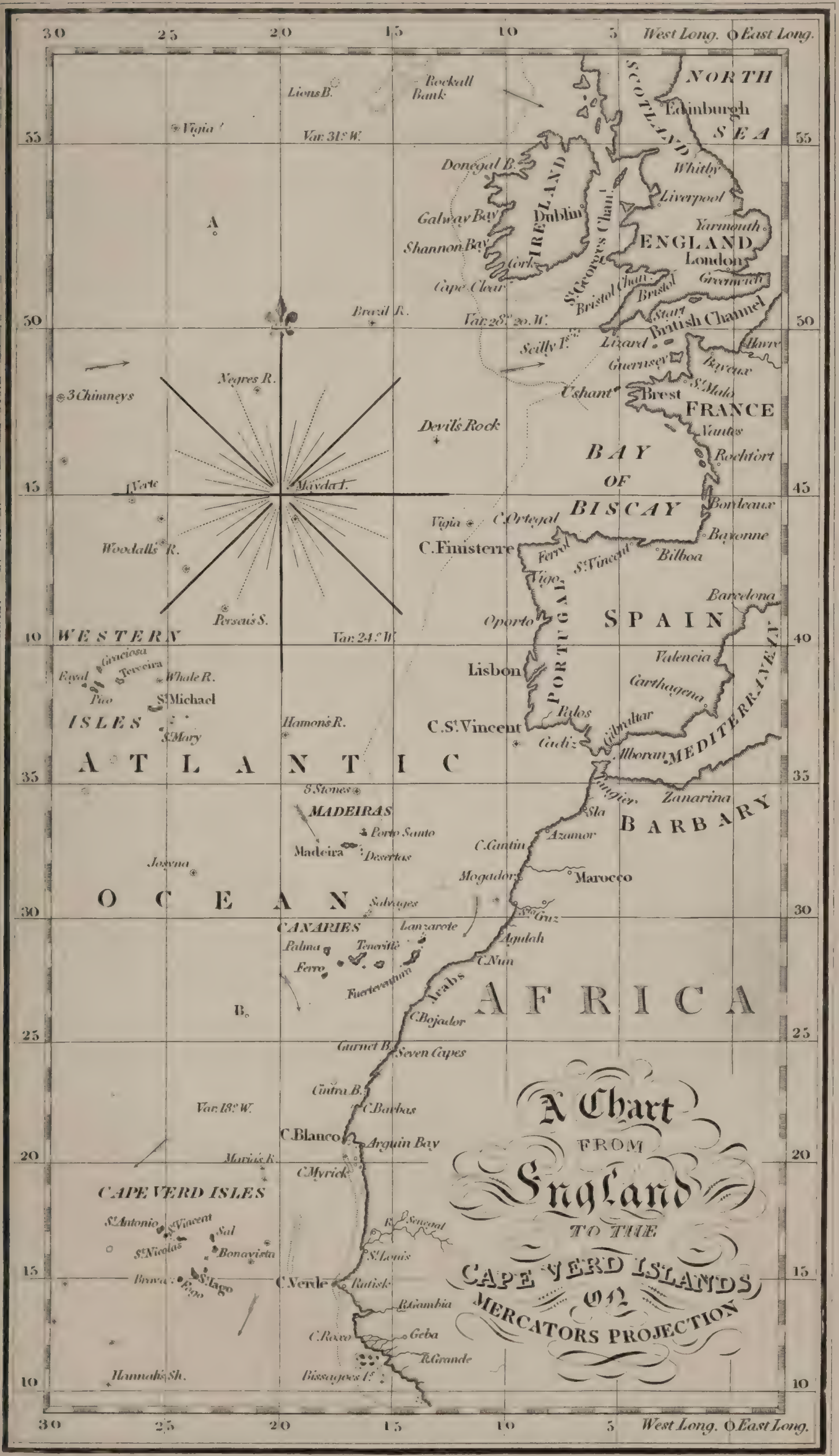
To find the Latitude and Longitude of a Place on the Chart.

With a pair of compasses take the least distance between the given place, and the nearest parallel of latitude; apply that distance, the same way, on one of the graduated meridians, one foot of the compasses being fixed at that point where the parallel cuts the graduated meridian, and the other will shew the latitude of the place.

The least distance between the given place and one of the nearest meridians being applied in the same manner to either of the graduated parallels, will point out the longitude of the place.

For example. The least distance between Cape St. Vincent and the parallel of 35° on the chart, being taken and applied to one of the graduated meridians from the same parallel upwards, will give its latitude about

Plate IV.



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37 degrees N ; and the least distance between the same Cape and the meridian of 10°, being applied to either graduated parallel, towards the right from that meridian, will give its longitude 9° West.

To lay down upon the Chart any Place whose Latitude and Longitude are given.

Lay the edge of a scale over the parallel of the given latitude, and with a pair of compasses take, from one of the divided parallels, the distance between the given longitude and the nearest meridian line: this being applied along the edge of the scale, from that point where the scale intersects the meridian line, the same way that the longitude lies, will point out the place required.

Example. Suppose a ship be in latitude 52°30′ N., and longitude 23° W.· required its situation on the chart.

Lay the edge of the scale over latitude 52° 30′ N., and take from one of the divided parallels the distance between the meridian of 20°, and the longitude 23° ; this being laid off along the edge of the scale, towards the left, from the meridian of 20°, will give the ship's place at A.

In this manner a ship's track is usually pricked off at sea, her latitude and longitude being laid down every day at noon; and the ship's places connected by pencil-lines drawn between them.

To find the Course or Bearing between two Places on the Chart.

Lay the edge of a scale over the given places, and take the least distance between the centre of one of the compasses drawn on the chart, and the edge of the scale; move this extent along, so that one point of the compass may touch the edge of the scale, while the other is to be kept in a perpendicular position to it, with respect to the edge of the scale; then that other point will generate an imaginary line, passing through the centre of the compass on the chart, which will shew the course or bearing.

Or, with a parallel rule, lay one of its edges over both the places; then move the two parts of the rule in succession, until the edge of one of them pass through the centre of a compass on the chart; and that edge will point out the course.

To find the Distance between any two Places on the Chart.

1. If the given places lay under the same meridian, find their latitudes on the chart; and the difference or sum of these, according as the places lay on the same, or on different sides of the equator, will give the distance.

2. If the given places lay in the same parallel of latitude, take half the distance between them, and placing one foot of the compasses in the graduated meridian on their latitude, observe what latitudes the other foot points to, both above and below: the difference between these will be their distance

3. But if the given places differ both in latitude and longitude, take the distance between them, and apply it to either of the graduated meridians, so that one foot of the compasses may be as much above one place as the other is below the other place; then the degrees or minutes contained between the points of the compasses, will be the distance required, which may be reduced to miles or leagues.

But if the places lay nearly in a parallel, and their distance be considerable, it will conduce to accuracy if the middle latitude between the two places be found; then half their distance being applied alternately above and below the middle latitude, will give the distance:

Or, a degree may be taken near the middle parallel, and the number of these degrees and parts contained between the two places being measured along the edge of the scale, will give the distance.

The distance may also be found in the following manner:—Find the difference of latitude between the given places, and take it from the equator, or one of the graduated parallels; then lay the edge of a scale over the given places, and move or slide one point of the compasses along the edge of the scale (keeping both points parallel to the meridians), until the other point just touch a parallel. Now, the distance between the place where the point of the compasses rested, and the point of intersection of the edge of the scale and parallel, being applied to the equator, or one of the graduated parallels, will give the distance in degrees and parts, which may be reduced to miles.

Example. Required the course and distance from Cape St. Vincent to the east end of the Island of Madeira.

Lay the edge of a scale over the two places, and take the least distance between it and the centre of the compass; then sliding one point along the edge of the scale, the other will shew the course to be S. W. b. W. nearly: the extent between the two places being taken with the compasses, and applied to one of the graduated meridians, will reach from 31° to about 38° 40′, being an interval of 7° 40′: hence the distance is 460 miles.

Or, take the difference of latitude between the two places, which is 4° 19′, from either of the graduated parallels, and laying the edge of the scale over the two places, move one point of the compasses along it until the other just touch a parallel, as that of 35°; then the extent between the place where the foot of the compasses rested, and the point where the scale cuts the parallel of 35°, being applied to the graduated parallel, will give the distance 7° 40′, or 460 miles, as before.

The Course steered, and Distance run from any given Place, being known, to find the Ship's Place on the Chart.

Lay the edge of the scale over the given place in the direction of the ship's course; then take the distance run from that part of one of the graduated meridians opposite the given place and the supposed place of the ship, which lay off from the given place along the edge of the scale, and it will shew the place of the ship. Or, placing the scale as before directed, take the given distance from one of the graduated parallels; put one foot of the compasses in that point of a parallel that is cut by the edge of the scale, and the other foot will reach to a certain place along the edge of the scale. Now this foot remaining in the same position, draw in the other point of the compasses until it just touch the above parallel, without crossing it; apply this extent to the graduated parallel, and it will give the difference of latitude: hence the latitude in will be known, through which a parallel being drawn, that point where it intersects the edge of the scale, will be the ship's place.

Example. Suppose a ship sail N. W. b. N. 400 miles from Cape Blanco; required her place on the Chart.

By either of the above methods the ship's place will be found at B, in latitude 26° 23 N., and in longitude 21° 10′ W.

MARINE SURVEYING.

NOTWITHSTANDING the great importance of accurate surveys of the various coasts and harbours that are frequented by mariners, it must be confessed that the manner of executing this branch of the nautical Art has been but little attended to, and that the opportunities which so frequently occur to seamen of adding to our present stock of geographical knowledge, are almost entirely neglected, or at least such incorrect observations made, as can be of little service to the attainment of truth. We therefore think it proper, before we proceed to the astronomical part of the Work, to lay down a few general directions, illustrated by proper examples, shewing how a coast or harbour may be easily surveyed with such instruments as are commonly used at sea; and we shall at the same time explain the method of delineating the observations on paper.*

To survey a Bay or Harbour

Take a general view of the place, by walking or sailing round it. During this time make a rough sketch of the coast, carefully drawing the various projections and bendings, and noting whatever is remarkable. On the principal points and curves place station-staves, or strait poles, high enough to be seen at a considerable distance; and, to render these more conspicuous, fasten a piece of white bunting to the top of them: if there be a tree. house, or other remarkable object at any of these places, it may serve instead of a station-staff; these are all to be marked down on the eye-sketch, either with letters or numbers, in order to distinguish them.

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* Those who are desirous of obtaining further information on this subject, may consult the following Works :—" A Treatise on Marine Surveying, by Murdoch Mackenzie, Sen., corrected and republished, with a Supplement, by James Horsburgh, F. R. S., &c."—" An Introduction to the Practice of Nautical Surveying, and the Construction of Sea Charts translated from the French of C. F. Beautemps-Beaupre, by Captain R. Copeland, R. N.' or " A Treatise on Nautical Surveying, by Commander Edward Belcher, R. N."

Proceed now to determine the position of the stations by observations made either on shore or on the water. In the former case, find a level spot of ground near the shore whereon a base-line may be measured, which base-line must be so situated, that the whole, or the most part, of the stations, or remarkable objects, may be seen from both the extremities; and its length and direction, if possible, such, that the angle contained between it and any of the station-staves taken from one end, may differ at least ten degrees from the same taken from the other end thereof. Then set up two station-staves; the further these are from each other, in general, the better; carefully measure their distance either by a chain, a measuring pole, or a piece of log-line divided into feet, and observe their bearing as accurately as possible by an azimuth compass.

If a base-line of sufficient length cannot be taken in one right line, two adjoining lines and their included angle may be measured, and the distance between their extremes found either by construction or computation, which may be considered as a base: the bearing of this line may be ascertained from that of one of the measured lines and the adjacent angle.

When the survey cannot be taken on shore, (which, however, is always to be preferred, on account of the superior accuracy with which the observations can be made), a base-line may be laid down on the water, by mooring two buoys in the most convenient situations, and measuring, as accurately as possible, their bearing and distance from each other.

Having fixed upon a base-line, from each extremity, observe the bearing of the several remarked objects, and note them down in their proper order; or rather, with a quadrant or sextant, observe the angles formed between the base-line and lines drawn from each end to the several stations. If any of the angles exceed the limits of the instrument, it may be measured at twice, by taking the angular distance of some intermediate object from each extreme object. These bearings or angles are all to be entered on paper, as they are taken, and distinguished by the letters marked on the rough sketch.

If any of the objects be not visible from both or either end of the base-line, their positions must be ascertained by angles taken from stations whose situations are already known. Sometimes it will be necessary to measure out a new base, which is to be connected, if possible, with the first base, either by angles taken from both extremities of the first base, or from one extremity and a station-staff, or from two station-staves whose positions have been previously determined.

When the survey is made by base-lines on the water, if all the principal points cannot be seen from two stations, moor as many buoys as are necessary, and observe their bearings and distances from each other, which set down in the manner of a Traverse; bearings or angles being then taken from any two of them whose situations have been determined, will give the positions of the places required.

Having proceeded so far on the survey, it will be proper to lay down the observations on paper; for which purpose describe a circle with the chord of 60°, and through its centre draw the magnetic north and south line: on this circle lay off the bearing of the base, and draw a line parallel to it on a convenient part of the paper, to represent the position and length of the base. From each end of the base draw lines parallel to the respective observed bearings, previously laid down on the circle; or if angles between the base-line and the stations be observed, a circle is to be drawn at each end of the base on which they are to be laid off; then the intersection of each pair of corresponding lines will give the position of the stations, between each of which the configuration of the coast is to be drawn from the sketches already made.

Now sail about the harbour at low water, and take the soundings or depths of the sea, observing whether the ground be rocky, sandy, shelly, &c. At the place where each sounding is taken, observe the bearings of two remarkable objects, whose positions had been previously determined: hence its situation may be laid down on the chart, where the depth of water is to be denoted by small numeral figures. In like manner determine the situation of rocks, shoals, anchoring-places, &c. that may be in or near the harbour, and mark them down accordingly*. Observe the set and velocity of the tide of flood, by heaving the log while at anchor, and denote the same on the chart by small darts. The time of high water, at new and full moon, is to be inserted in Roman numeral letters; rocks are to be denoted by small crosses; sands by dotted shading; good anchoring-places by a small anchor, and stopping places by a small anchor without a stock. Whilst going on with the necessary operations on the water, take particular care, on coming near the shore, to correct the outline of the chart, by observing the inflection, creeks, &c. more minutely.

In a small sailing vessel go out to sea, and take drawings of the appearance of the land, with its bearings. Sail into the harbour, observe the appearance of its entrance, and particularly whether there be any false resemblance of an entrance, by which ships may be deceived into danger. Remark the signs or objects, by attending to which, the harbour may be entered with safety; more especially, where it can be done, let the ship steer to the anchoring-place, keeping two remarkable objects in one, or in a line. These leading marks are to be inserted on the draught, by drawing fine double lines through the objects.

The necessary observations being all laid down on the chart, shade the coast on the land-side with Indian ink, and draw houses, churches, trees, &c. in their proper places; the coast should be shaded so as to exhibit, as nearly as possible, its natural appearance, particularly shewing whether it be high, low, sandy, rocky, bad shore, &c. In a convenient place insert a Mariner's Compass, by which the situation of the rhumbs will be shewn: this may be drawn either according to the magnetic or true north, as may be thought proper; the variation is to be marked by placing a small fleur de lis at the north point from which the compass is not drawn. The name of the place, on what coast or country, the latitude and longitude, and whatever else may be thought necessary, are to be ascertained and inserted in the chart.

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* When the relative positions of three stations are well determined, a fourth station may be found, as shewn in Example V. of Oblique Sailing: in this manner the situation of rocks, shoals, soundings, &c. may be accurately laid down.

To survey a Coast while sailing along it.

When the ship has arrived at a convenient situation, from whence there is a tolerably extensive view of the coast, there cast anchor, or lay-to as steady as possible; then, while the vessel is in this stationary position, observe, with an azimuth compass, the bearings of the most material projections and hollows, and whatever objects are remarkable on the coast; or rather, take the bearing of one of the most conspicuous points, and observe, with a quadrant or sextant, the angular distances contained between it and the other remarkable objects; write these down on paper, and make a rough sketch of the coast, on which mark the observed points, &c. with letters, for the sake of reference.

Then let the ship run in a direct line upon a known course, measuring the distance with all imaginable care by a log, or otherwise; during which time take soundings, and draw a more correct sketch of the coast, with appearances of land, &c. When she has at length attained a proper situation, from whence the same points and objects before observed may be still seen, lay-to, as at the first station, and again observe the bearings or angles of the former objects, and likewise of others in the continuation of the coast, which note down as before: in this manner proceed from station to station, until the survey be extended as far as may be thought proper.

The observations are to be laid down on paper, by drawing the ship's courses and distances between the stations, in the manner of a Traverse, and setting off the bearings and angles observed at each station; then the intersection of the corresponding lines will give the position of the several observed points and objects, through which the configuration of the coast is to be drawn from the sketches made while sailing along it.

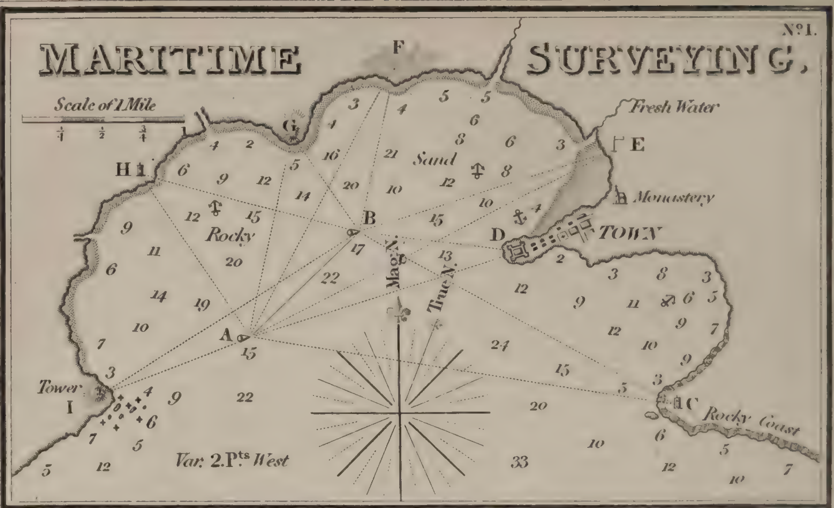
To reduce a Draught to any Scale required.

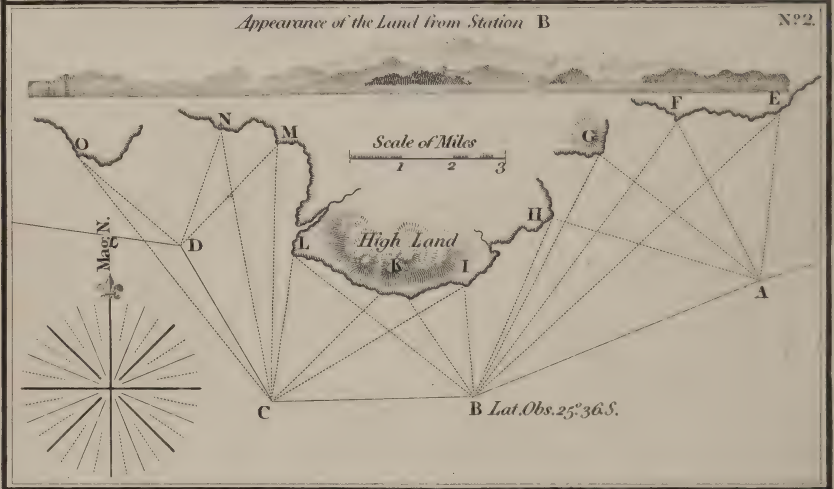
Surveys being usually drawn upon a large scale, for the sake of accuracy, it frequently becomes necessary to reduce them to a smaller, when they are used in the construction of charts, in order to adapt them to that particular scale on which the other parts of the chart are drawn: this may be performed several ways; but the following is the easiest, and the most convenient in practice.

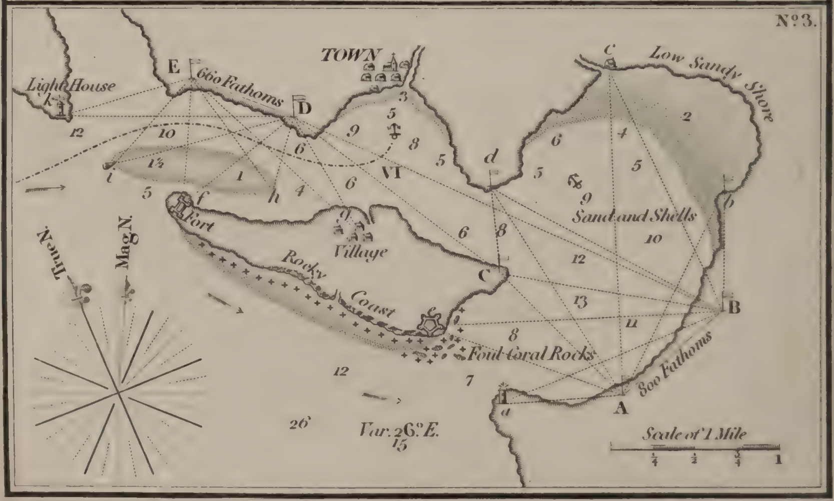
Divide the whole, or that part of the draught to be copied, into small squares, by setting off any convenient number of equal divisions on the marginal lines, and through these drawing lines across the draught with a black-lead pencil; in like manner divide that part of the paper on which the copy is to be taken, into the same number of squares. If the divisions round the margins be numbered alike on both draughts, or if every fourth or fifth line be drawn somewhat stronger than the rest, the corresponding squares will be more readily discovered. With a pencil draw in such lines, curves, and other particulars on the copy as are found in the corresponding squares of the former draught: when the whole is thus correctly copied, draw the lines, &c. over with a pen dipped in Indian ink dissolved in water, and when dry, rub out the pencil-lines with Indian rubber, or crumbs of stale bread.

We shall now proceed to elucidate what has been said on Surveying, by the three following Examples, each of which exhibits a different method of conducting the operation.

Plate V.







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EXAMPLE I

Let it be required to survey the harbour (No. 1, Plate V.) by observations made on the water.

Having sailed round the harbour, and fixed upon the several stations on the coast, let the two buoys, A and B, be moored so that all the points or stations may be seen from both, whose bearing, from A to B, as observed by an azimuth compass, suppose to be N. 46° E., and their distance measured by a log, one mile*; then having taken the boat to the stations A and B, suppose the following bearings to have been taken.

From Station A.	From Station B.
AC = N. 100° E.	BC = N. 121° E.
AD = N. 72 E.	BD = N. 99 E.
AE = N. 63 E.	BE = N. 73 E.
AF = N. 29 E.	BF = N. 12 E.
AG = N. 12 E.	BG = N. 36 W.
AH = N. 33 W.	BH = N. 74 W.
AI = N. 110 W.	BI = N. 122 W.

The above bearings being observed, proceed to draw the plan as follows In a convenient part of the paper describe a circle, with the chord of 60° and through the centre draw a line, to represent the magnetic meridian, or north and south line; on this circle lay off the bearings, as above, and through A and B draw lines parallel to them; then the intersection of these lines will give the position of the points CDEFGHI, through which draw the configuration of the coast, according to the sketch previously made, and insert the isles, rocks, shoals, and sand-banks, that lay within or near the harbour, with the marks to avoid them, the proper places for anchoring, the depth of water in various parts, the variation of the compass, and whatever other particulars may appear worthy of notice.

EXAMPLE II

Wanting to survey a coast whilst sailing along it, I ran from A to B (No. 2, Plate V.) W. S. W. 6 miles; from B to C, West 4 miles; and from C to D, N. N. W. $\frac{1}{2}$ W. $3\frac{1}{2}$ miles; taking the following bearings and angles at each station:

1. From Station A.	2. From Station B.
The Bearing of AG = N. 51° 0′ W.	The Bearing of BK = N. 33° 0′ W.
The Angle GAE = 58 40	The Angle KBL = 17 40
—— GAF = 25 0	—— KBI = 28 35
—— GAH = 21 50	—— KBH = 56 0
	—— KBG = 60 0
	—— KBF = 69 40
	—— KBE = 80 3

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* In a case like this, where it is necessary to make the observations on the water, as it will be difficult to measure accurately the distance between the buoys, the same may be ascertained between any two of the stations on shore, which will furnish a scale for the plan; and the bearings or angles being taken from the buoys, will shew the relative position of the stations.

3. From Station C.

The Bearing of	CK	=	N.	46°	0′ E.
The Angle	KCI	=		13	16
——	KCL	=		36	30
——	KCM	=		44	0
——	KCN	=		55	45
——	KCO	=		83	26

4. From Station D.

The Bearing of	DN	=	N.	20°	0′ E.
The Angle	NDO	=		67	50
——	NDM	=		22	5

To delineate these observations on paper, first draw a compass in a convenient part, and fix upon a point, as A, for the first station; through which draw the line AB parallel to the W. S. W. rhumb-line, and equal to 6 miles, the distance run on that rhumb; then will B be the second station: proceed in like manner with the second and third courses, by which you will obtain the third and fourth stations, C and D. Through A draw the line AG parallel to N. 51° W., laid off on the compass, and make the angles GAE, GAF, GAH, according to the above observations: in the same manner the bearings and angles are to be laid down from the other stations; then the intersecting lines will give the points EFG, &c., through which the coast is to be drawn, agreeably to the sketches made at the time of passing along it. The scale of miles is to be laid down from the same equal parts as the distances run were measured by.

EXAMPLE III.

Let it be required to take an accurate survey, and from thence to make a chart of the harbour and adjacent island, (No. 3, Plate V.)

Sail round the coasts to be surveyed, and fix station-staves on the principal points, where there are no remarkable objects to distinguish them: at the same time take a rough sketch of the harbour, on which denote the situation of the objects and stations by the letters *a*, *b*, *c*, &c.; it will likewise be advisable to take a more particular sketch of the coasts between each station, on a separate piece of paper. Seek for a proper place near the shore, on which a base-line may be measured; and, since there is no part of the coast which commands a view of all the stations, it will be necessary to measure out two base-lines: accordingly the base-line AB is fixed upon, the ground being there level, and a considerable number of station-staves visible from each extremity: its length, as measured by a chain, is 800 fathoms, and its bearing from A to B, N. 48° E. From each end measure the angles contained between the base-line and the several stations within sight, which are as follow:

From Station A.

The Angle	BA *b*	=	23°	35′
——	BA *c*	=	52	10
——	BA *d*	=	82	0
——	BAC	=	94	0
——	CA *e*	=	25	13
——	CA *a*	=	47	30

From Station B.

The Angle	AB *a*	=	18°	40′
——	AB *e*	=	38	0
——	ABC	=	50	15
——	ABD	=	66	0
——	AB *d*	=	69	36
——	*d* B *c*	=	36	25
——	*d* B *b*	=	61	10

It will now be necessary to fix upon a place whereon another base-line may be measured, from whence the remaining stations may be seen. The most convenient spot is between D and E; let D E, therefore, be the second base-line, its length being 660 fathoms, and bearing from D to E, N. 72° W.; but as its southern extremity D can be seen only from one end of the first base, the angle d C D is to be observed from C, in order to ascertain the position of the second base with regard to the first; this angle is found to be 44° 0′; now measure the angles formed by lines drawn from each end of this base to the station-staves, or other objects, which are as follow:

From Station D.			From Station E.		
The Angle E D k	= 21°	15′	The Angle D E g	= 22°	28′
—— E D f	= 59	42	—— D E f	= 74	0
—— f D g	= 79	25	—— f E k	= 70	0

Having taken all the necessary bearings and angles on shore, lay them down upon paper agreeably to the preceding directions: hence the relative position of the points a, A, B, b, c, d, D, E, C, e, f, g, and k, will be obtained; which are to be connected by drawing the configuration of the coast from the sketches made whilst sailing round the harbour and island. The chart being thus far delineated, proceed to make the requisite observations on the water. In sounding for the depths of water, a shoal is discovered in one of the entrances: now its extremes i h are to be ascertained by their bearings from the stations D and E; the bearing of i E is N. 40° E., and of i D, N. 72° E.; also the bearing of h E is N. 40° W., and of h D N. 10° E.: to lay these down on the chart, through E and D draw lines parallel to the above bearings, which are to be previously laid off on the compass; these will meet at i and h, and determine the extremities of the shoal.* In the same way the positions of the soundings, anchoring places, rocks, &c. are to be ascertained and laid down.

The above bearings being all magnetic, and it being thought proper to draw a compass according to the true meridian, the variation, which is 26° easterly, is to be laid off to the left of the magnetic north; hence the direction of the true meridian and the other rhumb-lines will be obtained.

The scale shews the length of a geographical mile, containing 1013 fathoms; therefore take 1013 from the same scale of equal parts that was used in laying down the base-lines; or, make the transverse distance of 400 on the sector, equal to the length of the base A B; then the transverse distance of 506 will be the length of one mile. (See Use of Sector, page 32.)

The following methods of ascertaining the heights and distances of remote objects being frequently useful, particularly in the practice of surveying, we think it proper to introduce them before we dismiss the present subject.

To find the Height of an accessible Object.

Measure the horizontal distance, between the eye and the object, of the point immediately under it, and observe the angle of elevation with a quadrant: thus will be obtained the base and angles of a right-angled triangle, the perpendicular of which being found, will be the height of the object above the horizontal plane, to which add the height of the eye.

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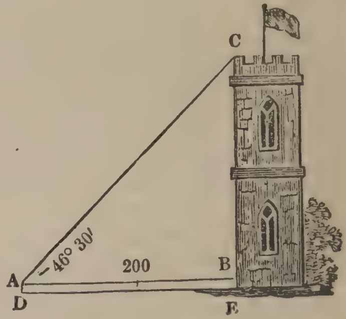
* Or, more accurately, by taking the angles subtended by the Stations D, E, k, at i and h, the extremities of the shoal, as shewn in Example V. of Oblique Sailing.

Or, by removing either towards or from the object, until the angle of elevation be 45°, the horizontal distance, added to the height of the eye, will give the height of the object.

EXAMPLE.

From the bottom of a tower I measured 200 feet on a horizontal plane; I then took the angle of elevation, and found it 46° 30′, the height of my eye being 6 feet: required the height of the tower.

In the triangle ABC are given the side AB 200 feet, and the angle BAC 46° 30′, to find the perpendicular BC.



As radius 10. 00000
Is to the distance AB or DE 200... 2. 30103
So is tang. angle BAC 46° 30′...... 10. 02275

To the perpendicular BC 210. 7 2. 32378
Height of the eye AD or BE 6

Height of the tower CE ... 216. 7 feet

If the height of the object be known, and the angle of elevation observed, the horizontal distance of the eye may be found; for in this case there will be given the perpendicular and angles of a right-angled triangle to find the base or distance required.

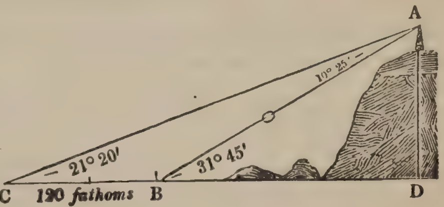
To find the Height of an inaccessible Object.

Measure the angle of elevation at a convenient distance from the given object; then remove in a direct line from the object, and again observe the angle of elevation, the distance between the stations being carefully measured: hence will be given one side and the angles of an oblique-angled triangle, with which, find the less of the other sides. Now that side will be the hypothenuse of a right-angled triangle, the perpendicular of which being found, and the height of the eye added to it, their sum will be the height of the object.

EXAMPLE.

Wanting to know the height of a lighthouse above the level of the sea, and not being able to measure its horizontal distance, I took the angle of elevation, and found it to be 31° 45′, and after removing from it 120 fathoms, I observed the angle of elevation to be 21° 20′: required the height of the lighthouse.

In the triangle ABC are given the angle ACB 21° 20′; the angle CAB 10° 25′; and the side CB 120 fathoms, to find the side BA.



Angle ACB......	21°	20′
Angle ABC......	148	15
	169	35
	180	0
Angle CAB......	10	25

As sine angle CAB 10° 25′	9. 25721
Is to the side CB 120	2. 07918
So is sine angle ACB 21° 20′	9. 56085
	11. 64003
	9. 25721
To the side AB 241. 4	2. 38282

In the right-angled triangle ABD are given the angle ABD 31° 45′, and the hypothenuse AB 241. 4, to find the perpendicular AD.

As radius	10. 00000
Is to the hypothenuse AB 241. 4...	2. 38274
So is sine of angle ABD 31° 45′ ...	9. 72116
To the perpendicular AD 127	2. 10390

Hence the height of the lighthouse is 127 fathoms, or 762 feet above the level of the sea.

In this example the height of the eye is neglected; for, supposing the observations to have been made in a boat, the eye would nearly coincide with the surface of the water, and hence the omission would lead to no material error.

Shorter methods might have been given for solving the above; but as the present is worked directly by the Rules of Trigonometry, it is more likely to be retained in the memory.

To find the Distance of Objects at Sea by Means of the Curvature of the Earth.

To the logarithm of the diameter of the earth, increased by the height of the eye, add the logarithm of that height, and half the sum will be the logarithm of the distance of the visible horizon in feet; from which subtract the constant logarithm 3. 783904, and the remainder will be the distance in nautical miles, to which add a twelfth part of the distance, on account of terrestrial refraction.

EXAMPLE.

At what distance is the visible horizon from a person, whose eye is elevated 120 feet above the surface of the water?

Diameter of the earth in feet……	41804400		
Height of the eye ………………	120	Log.	2. 079181
	41804520	Log.	7. 621223
			9. 700404
Distance in feet …………………	70827. 5	Log.	4. 850202
		Constant Log.	3. 783904
Distance in nautical miles ………	11. 65	Log.	1. 066298
Add one-twelfth part ……………	0. 97		
Distance corrected for refraction..	12. 62		

When the height of a distant object appearing in the horizon is given its distance from the eye is found by adding together the distances answering to each height. (See Explanation to Table XX.)

To find the Distance of an Object, by observing the Interval between the Flash and Report of a Gun.

Multiply 1142 (the number of feet sound travels in a second) by the number of seconds in the above interval; and the product will be the distance in feet, which, divided by 6079, will give the distance in nautical miles.

EXAMPLE.

A ship at sea was observed to fire a gun, and 24 seconds afterwards the report was heard: required the distance of the ship from the observer.

1142 multiplied by 24 gives 27408, the distance in feet, which, divided by 6079, gives 4½ miles.

ASTRONOMY.

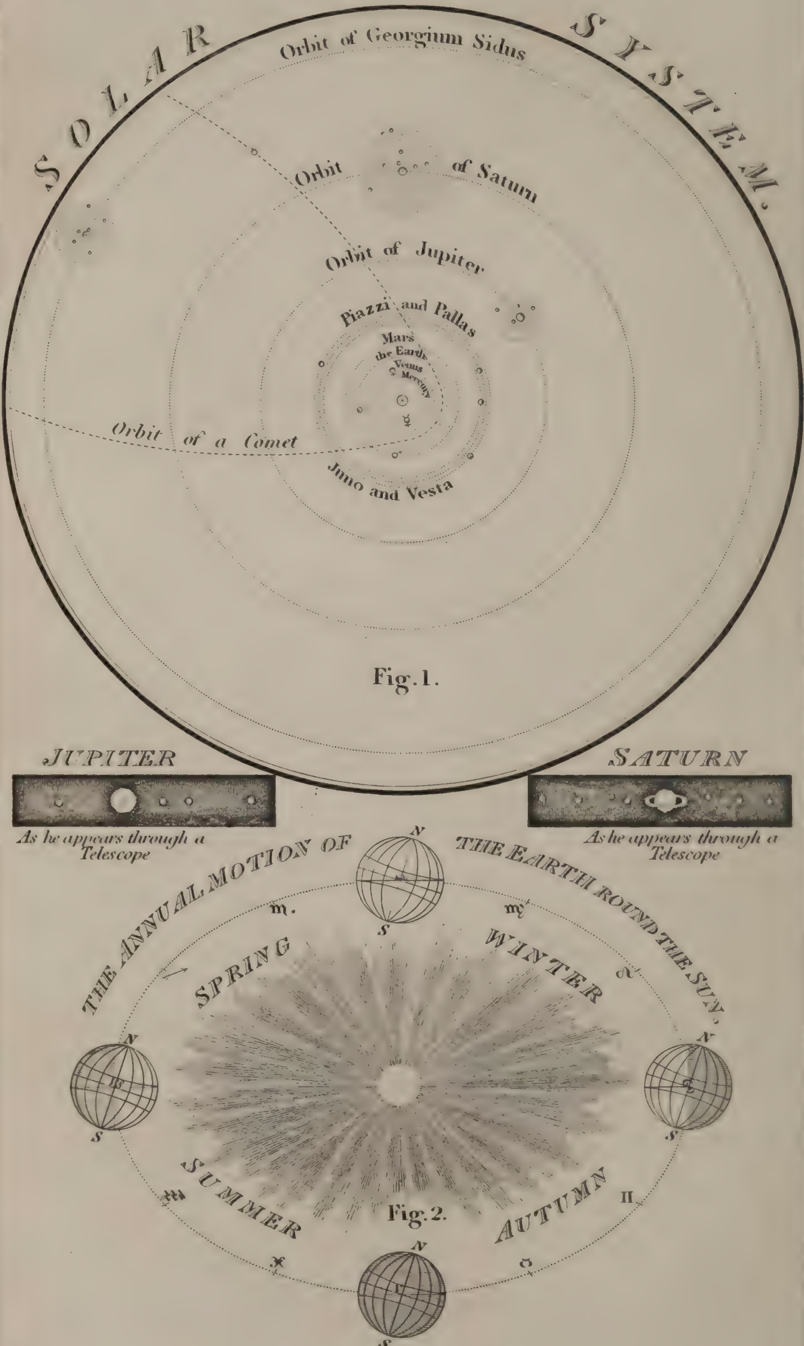


Fig. 1.

Fig. 2.

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ASTRONOMY.

ASTRONOMY is a science which treats of the motions and distances of the heavenly bodies, and of the appearances thence arising.

A great variety of opinions prevailed, at different times, among philosophers of former ages, concerning the order and arrangement of the several parts of the universe, or of the positions of those bodies which appear in the heavens. The most eminent Astronomers of the present day suppose the universe composed of an infinite number of systems or worlds, that in every system there are certain bodies moving in free space, and revolving at different distances around a sun, placed in or near the centre of the system, and that these suns and other bodies are the *stars* which are seen in the heavens.

The STARS are distinguished into two kinds, *viz. fixed* and *wandering*. The fixed stars are supposed to be suns in the centre of their systems, shining with their own light, and preserving always the same situations with respect to each other: they are usually divided, according to their apparent splendour, into different classes, called *magnitudes;* the brightest being denominated stars of the first magnitude; the next to them in brightness, of the second magnitude; and so on to those stars that are scarcely visible to the naked eye, which are termed stars of the sixth or seventh magnitude.

In order to assist the memory, Astronomers have divided the heavens into parcels, called *constellations:* these are a number of fixed stars, lying contiguous, which are supposed to be circumscribed by the outline of some animal, or other imaginary figure. Stars which are not included within the constellations, are called *unformed stars.* The stars in each constellation are generally distinguished by letters of the Greek alphabet, and some of the principal have proper names: thus the star marked α, in the constellation of Taurus, is called *Aldebaran*.

The wandering stars are those bodies within our system which revolve round the sun; they appear luminous, by reflecting the light they receive from the sun, and are of three kinds, namely, *primary planets*, *secondary planets*, and *comets*.

PRIMARY PLANETS are those bodies which, in revolving round the sun, respect him only as the centre of their revolution; their motions are regularly performed in tracks or paths, called ORBITS, which are nearly circular and concentric with each other.

A SECONDARY PLANET, called also a SATELLITE or MOON, is a body which, while it is carried round the sun, also revolves round a primary planet, which it respects as its centre.

COMETS are a kind of planets which move round the sun in very eccentric orbits, and in various directions, having vast atmospheres about them, and tails of a hairy or nebulous appearance, especially when they are near the sun.

OF THE SOLAR SYSTEM.

The SOLAR SYSTEM is that in which our earth is placed, and in which the sun is supposed to be fixed near the centre, with several bodies similar to our earth revolving round him at different distances. This hypothesis, which is the only one that can explain all the phenomena of the heavenly bodies, is said to have been first taught by Pythagoras; after whose time it remained many ages in oblivion, until it was revived, in the beginning of the sixteenth century, by Copernicus, and has since been fully established on the firm basis of demonstration by the immortal Newton.

There are eleven primary planets in our system, accompanied by at least sixteen satellites. The names of the primary planets, with their characters, reckoned in order from the Sun ⊙, are as follow:—Mercury ☿, Venus ♀, Earth ⊕, Mars ♂, Vesta ⚶, Juno ⚵, Ceres ⚳, Pallas ⚴, Jupiter ♃, Saturn ♄, and Uranus, Herschel. or Georgium Sidus ♅ (See Plate VI. Fig. I.)

Mercury and Venus are called *inferior planets*, because their orbits are within the Earth's; the others are called *superior planets*, as their orbits include that of the Earth.

The primary planets, accompanied by their satellites, revolve round the sun from west to east, in various portions of time, which are called their *periodic revolution*, or *annual motion;* the planes of their orbits all pass through the centre of the sun, but are inclined more or less to that of the earth, crossing it in two points, called *Nodes.*

Although to an observer placed in the sun, the planets would appear to move in due order about him, from west to east, yet, since the earth is not in the centre of the system, their apparent motions in the heavens are very irregular: sometimes they appear to move from west to east, and then to stand still; then they seem to move from east to west, and after standing some time, they again move from west to east, and so on continually. The motion of a planet from west to east is called the *direct* motion, or according to the order of the signs. The contrary motion from east to west is called *retrograde;* and when the planet appears to stand still, it is said to be *stationary.*

The situation of a planet in the heavens, as it would appear if seen from the sun, is called its *heliocentric place;* and as seen from the earth, its *geocentric place.*

The angular distance of a planet from the sun is termed its *elongation.*

When a planet is in the same part of the heavens with the sun, those bodies are said to be in *conjunction;* and when their angular distance is 180°, in *opposition.* The same terms are used with respect to any other two celestial bodies.

We now proceed to give a more particular description of the sun and the planets.

The SUN, that great fountain of heat, light, and vegetation, is an immense spherical body, placed near the centre of the orbits of all the planets; its diameter is about 882,000 English miles, and it turns round its axis in 25 days 10 hours.

MERCURY is, of all the primary planets, the nearest to the sun: his diameter is about 3140 miles, and mean distance from that luminary above 36 millions of miles. His periodic revolution is performed in 87 days 23 hours.

To a spectator on the earth this planet keeps so near the sun, that we can seldom discern him without the aid of telescopes: he appears sometimes a little before sunset, and at other times a little after sunrise.

VENUS is the next planet in the order of the system, and is distinguished by her superior brilliancy; her diameter is 7687 miles, her mean distance from the sun nearly 68 millions of miles, and her periodic revolution is performed in 224 days 17 hours.

This planet appears to us always near the sun, although she recedes from him almost double the distance of Mercury; when she is in that part of her orbit which is west of the sun, she rises before him in the morning, and is called *Lucifer*, or the morning star; and when she is in the eastern part of her orbit, she shines in the evening after he sets, and is called *Vesper*, or the evening star.

The EARTH, or planet which we inhabit, is about 7916 English miles in diameter, and is about 95 millions of miles from the sun; it performs a revolution through its orbit in 365 days 6 hours, which period is called a *year*, and revolves round its axis, from west to east, in 24 hours, which occasions the apparent diurnal motion of the sun, and all the heavenly bodies round it, from east to west, in the same time; it is of course the cause of their rising and setting, of day and night. The axis of the earth is inclined 23° 28′ from a perpendicular to the plane of its orbit, and keeps in a direction parallel to itself throughout its annual course, which causes the return of spring and summer, autumn and winter. Thus the diurnal motion gives us the grateful vicissitude of day and night; and the annual motion, the regular succession of the seasons. (See Plate VI. Figure 2.)

The earth is attended by a satellite called the MOON, whose diameter is about 2160 miles, her mean distance from the centre of the earth above 237,000 miles; she goes round her orbit in 27 days 8 hours, revolving round her axis in the same time; but the interval between each new moon is 29½ days; the former of these periods is termed a *periodic month*, and the latter a *synodic month*, or *lunation*.

As the moon, like the other planets, is an opaque body, and borrows her light from the sun, only one hemisphere is enlightened by the solar rays: hence she puts on various appearances, called *phases*, during her monthly course round the earth, as her illuminated side is more or less turned towards us: when she is in the same part of the heavens as the sun, her dark side being turned towards us, she is invisible, and this part of her period is called the *change*, or time of *new moon;* in a few days after, as she advances to the eastward of the sun, we see a small part of her enlightened face, and she assumes a horned appearance, the *cusps* or points being turned from the sun towards the east. When she has advanced 90° to the eastward of the sun, we then see half her illuminated face, and she is then said to be in her *first quarter;* as she proceeds on her journey, more of her enlightened side becomes visible, and she appears of an oval or gibbous form. At length, when she is in opposition to the sun, she presents to us the whole of her enlightened face, and this is called the time of *full moon*. In performing the other half of her revolution, she wanes, and exposes less and less of her enlightened side, till she entirely disappears, and comes again in conjunction with the sun. (See Plate VII. Figure 1.)

When the moon, at the time of conjunction, is directly between the sun and the earth, she will intercept a part of the sun's rays, and thence cause an *eclipse of the sun;* and when, in opposition, the earth is directly between her and the sun, she will pass through the shadow of the earth, and cause an *eclipse of the moon*. These eclipses would happen every revolution of the moon round the earth, if their orbits were in the same plane; but the moon's orbit is inclined to the earth's in an angle of about 5 degrees, crossing it in two opposite points, called the *moon's nodes;* hence eclipses of the sun and moon can happen only when the moon is in or near one of the nodes, she being, at all other times, above or below the plane of the earth's orbit. (See Plate VII. Figure 2.)

MARS is the least bright and elegant of all the planets, being of a dull red or fiery colour, supposed to arise from the density of his atmosphere; his diameter is 4100 miles; his distance from the sun 142 millions of miles; his periodic revolution is performed in about 687 days; and he revolves round his axis in 24 hours 40 minutes.

Mars, as well as all the other superior planets, is not subject to the same limitations in his apparent motion as Mercury or Venus, but appears sometimes near the sun, and at other times in opposition to him.

VESTA was discovered by Dr. Olbers, of Bremen, on the 29th of March, 1807; its distance from the sun is about 225½ millions of miles, and the length of its year, 3 years, 240 days, 5 hours. This planet appears like a star of the 5th magnitude.

JUNO was discovered by Mr. Harding, of Lilienthal, in the Duchy of Bremen, on the 1st of September, 1804. It appears like a star of the 8th magnitude; is distant from the sun about 253 millions of miles, and performs its revolution in 4 years, 131 days.

PIAZZI, or CERES, was discovered by M. Piazzi, the Astronomer Royal, at Palermo, in Sicily, on the 1st of January, 1801. Its periodic revolution is 4 years, 221 days, 13 hours; its diameter, as computed by Dr. Herschel, is about 162 miles, and its distance from the sun about 263 millions of miles. Ceres appears no larger than a star of the 8th magnitude, and therefore cannot be seen with the naked eye.

PALLAS was discovered by Dr. Olbers, at Bremen, on the 28th of March, 1802; it is distant from the sun near 263 millions of miles, and performs its revolution round it in 4 years, 221 days, 17 hours. Pallas appears like a star of the 7th magnitude, and its diameter is about 110 miles*.

JUPITER is the largest of all the planets, and is easily distinguished by his peculiar magnitude and light. His diameter is nearly 90,000 miles; his distance from the sun above 485 millions of miles; and he performs his

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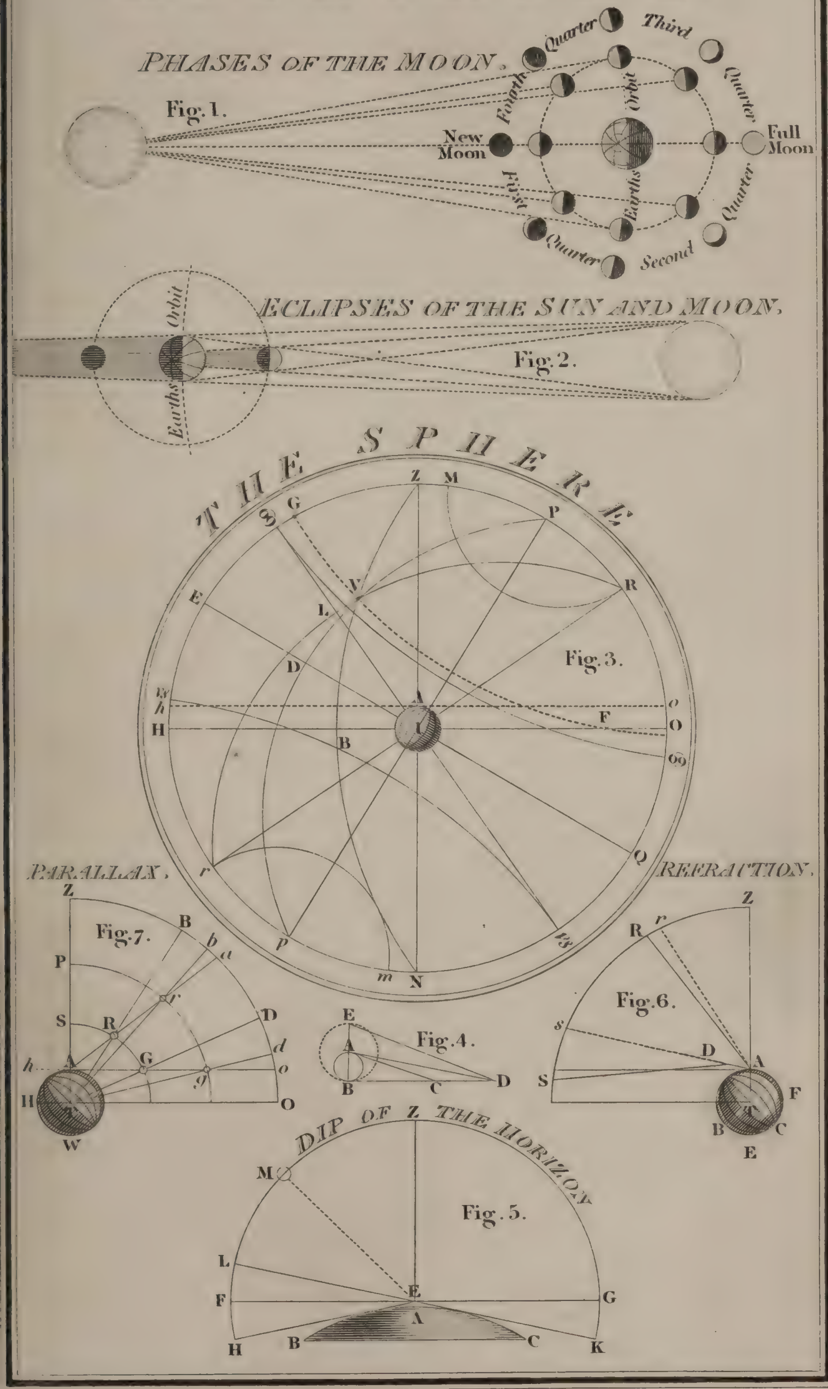
* Vesta, Juno, Ceres, and Pallas are called Asteroids.

Plate VII.

ASTRONOMY.



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periodic revolution in 4332½ days, or nearly 12 years. Jupiter completes his diurnal revolution in 9 hours and 56 minutes.

This planet is attended by four satellites, invisible to the naked eye, but through a telescope they make a beautiful appearance. In speaking of them, we distinguish them according to their places, into the first, the second, &c. The eclipses of these are of considerable use in determining the longitude of places on the earth. In viewing Jupiter through a telescope, we find several streaks or lines over his equatorial parts, which are called his *belts:* these are supposed to arise from the swiftness of his diurnal motion, which draws his clouds and vapours into those forms.

SATURN was reckoned the most remote planet of our system, before the discovery of the planet Herschel, now called Uranus. He shines but with a pale and feeble light; his diameter is about 76068 miles; his distance from the sun above 890 millions of miles, and his periodic revolution in his orbit is performed in about 29 years, 167 days. Saturn revolves round his axis in 10 hours, 29 minutes, and is attended by seven satellites.

This planet is surrounded by a large, broad, double, and luminous ring, at a distance from it equal to the breadth of the ring. This phenomenon is quite different from all others in the planetary system, and appears intended to increase the quantity of light received from the sun, which, on account of the vast distance of the planet, must be very small.

URANUS, or, as it is sometimes called, the GEORGIUM SIDUS, was discovered on March the 13th, 1781, by Dr. Herschel; though there are many reasons to suppose it had been seen before, but had been considered as a fixed star. Its diameter is about 35112 miles; its distance from the sun upwards of 1800 millions of miles, and its periodic revolution in its orbit is performed in 83 years and 52 days. This planet is attended by six satellites, which were likewise discovered by Dr. Herschel.

The number of COMETS that has been recorded in history is very great, amounting to several hundreds. One of the most remarkable of these erratic bodies is that which appeared in the years 1531, 1607, and 1682, and was predicted by the celebrated Dr. Halley to reappear in the year 1759, which it actually did; passing its perihelion, or nearest distance from the sun, on the 12th of March in that year, its periodical revolution being made in about 76 years. The next return of this comet to its perihelion was again computed by M. De Pontécoulant, a French astronomer, to take place on the 7th of November, 1835.*

OF THE SPHERE.

Although the celestial bodies are placed at different distances from the earth, as we have just seen, yet an observer living upon the earth, is not naturally sensible thereof, but imagines them all to be situate in one concave surface, of which the earth is the centre.

Likewise, though in reality the cause of day and night is the rotation of the earth round its own axis; and of the seasons, its motion through its own orbit in a year; yet to a spectator on the earth these appear to be effected by the motion of the sun or heavens.

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* It appeared within a *few days* of the time determined; and is predicted to reappear on the 1st day of July, 1911.

And as, in most astronomical problems, it is the apparent or relative motions only that we have to determine, therefore, for the ease of calculation, and since it amounts to the same thing whichsoever way these appearances are effected, astronomers consider it more convenient to suppose all celestial objects placed in one concave sphere, as above, and to ascribe to them all the motions which they seem to have, while the earth is considered as being at rest in the centre.

In order to point out the positions of the heavenly bodies in the celestial sphere, certain points, lines and circles are supposed to be described thereon.

Circles upon a sphere are either great or lesser. A *great circle* is that whose plane passes through the centre of the sphere. A *lesser circle* is that whose plane does not pass through the centre of the sphere: hence all great circles upon a sphere divide it equally, and all lesser circles divide it unequally.

Those two points on the surface of a sphere, which are equidistant from every part of the circumference of one of its great circles, are called the *poles* of that great circle.

If we imagine the axis of the earth produced to the celestial sphere, it is then called the *axis of the heavens*, and its extremities mark out two points in the sphere, which are called the *celestial poles*, or the *poles of the world*; one is termed the *north pole*, and the other the *south pole*. It is about these points that all the heavenly bodies appear to have a diurnal revolution.

The plane of the equator, in like manner produced to the heavens, forms a circle called the *celestial equator*, or *equinoctial*, whose poles are those of the world. This circle divides the heavens into two equal parts, called the *northern* and *southern hemispheres*.

Any celestial body situated in the equinoctial will appear to describe a great circle in the heavens; and those bodies which are situated north or south of it, will describe small circles, those stars situated at either pole will appear at rest.

The circle which bounds the view of a spectator, at sea, or on an open plain, is termed the *apparent*, or *visible horizon*; a circle whose plane passes through the eye of an observer, perpendicular to a plumb-line hanging freely, is called the *sensible horizon*; and a circle parallel to this, passing through the centre of the earth, is the *rational horizon*: these two circles in the sphere of the fixed stars may be considered as one and the same *

The *zenith* of a place is that point in the heavens immediately above the place, and the *nadir* is that point immediately under it. Hence the zenith and nadir are the poles of the rational horizon.

Azimuth or *vertical circles*, are great circles passing through the zenith and nadir, and therefore intersect the horizon at right angles. That vertical circle which passes through the east and west points of the horizon, is called the *prime vertical*.

Celestial meridians, or *circles of right ascension*, are great circles passing through the poles of the world, and cutting the equinoctial at right angles. Twenty-four of these circles which divide the equinoctial into equal parts, each containing 15 degrees, are called *hour circles*.

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* For the division of the horizon into points, &c., see the Mariner's Compass, opposite page 62.

The *meridian of a place* on the celestial sphere is that vertical circle which passes through the poles, crosses the equinoctial at right angles, and intersects the horizon at the north and south points. This circle is the terrestrial meridian of a place extended to the heavens: it divides the heavens into two hemispheres, termed the *eastern* and *western*. When the sun is upon the meridian of a place above the horizon, it is noon; and under the horizon, it is midnight. On this circle the latitude of a place is reckoned, being always equal to the elevation of the pole above the horizon, or to the distance of the zenith from the equinoctial.

The *altitude* of a celestial object is an arch of a vertical circle intercepted between the centre of the object and the horizon.

The *zenith distance* is an arch of a vertical circle contained between the object and the zenith. When the object is on the meridian, its altitude, or zenith distance, is called the *meridian altitude* or *meridian zenith distance.*

The *azimuth* is an arch of the horizon, contained between the azimuth, or vertical circle, passing through the centre of the object, and the meridian of the place.

The *amplitude* is an arch of the horizon, contained between the centre of the object, when rising or setting, and the east or west points of the horizon.

The *ecliptic* is that great circle in the heavens which the sun appears to describe in the course of a year, and is the orbit of the earth extended to the celestial sphere. It is inclined to the equinoctial, in an angle of about 23° 28′, called the *obliquity of the ecliptic*, and cuts it in two points diametrically opposite, called the *equinoctial points.* Those two points of the ecliptic, 90 degrees distant from the equinoctial points, are called the *solstitial points.*

The ecliptic is divided into twelve equal parts, called *signs*, each containing 30 degrees: these are thus marked and named.

1. Aries	♈	4. Cancer	♋	7. Libra	♎	10. Capricornus	♑
2. Taurus	♉	5. Leo	♌	8. Scorpio	♏	11. Aquarius	♒
3. Gemini	♊	6. Virgo	♍	9. Sagittarius	♐	12. Pisces	♓

The first six signs, being on the north side of the equinoctial, are termed *northern signs;* and the last six, on the south side, are called *southern signs*

The two points of the ecliptic which coincide with the equinoctial, are the beginning of Aries and Libra; the former of these is called the *vernal equinox*, and the latter the *autumnal equinox.*

The two solstitial points are situated at the beginning of Cancer and Capricorn, and are called the *summer* and *winter solstices.*

That great circle which passes through the equinoctial points and the poles of the earth, is called the *equinoctial colure;* and that great circle which passes through the solstitial points and the poles of the earth, is called the *solstitial colure*

The sun enters the beginning of Aries about the 21st of March; he then moves forward in the ecliptic, and advances towards the north pole till he enters Cancer, which happens about the 22d of June; then, continuing his motion according to the order of the signs, he apparently recedes from the north pole, and about the 23d of September enters Libra; still advancing in the ecliptic, he gets nearer to the south pole till he enters Capricorn about the 22d of December; after which, returning to the northward through the last three signs, he again enters Aries, and thus completes his annual course.

The *zodiac* is a space in the heavens extending about 8 degrees on each side of the ecliptic, like a belt or girdle, within which all the planets appear to perform their revolutions.*

Circles of longitude in the celestial sphere are great circles passing through the poles of the ecliptic, and therefore cut the ecliptic at right angles.

The *right ascension* of a celestial body is an arch of the equinoctial. contained between the first point of Aries and that point of the equinoctial which is cut by a meridian passing through the object.

The *ascensional difference* is an arch of the equinoctial, intercepted between the sun or star's meridian and that point of the equinoctial that rises with the object.

The *oblique ascension* or *descension* is the sum or difference of the right ascension and ascensional difference.

The *declination* of an object is an arch of a meridian contained between the equinoctial and the centre of the object. It is called north or south declination, according as the object is on the north or south side of the equinoctial.

The *polar distance* is an arch of the meridian contained between the centre of the object and either pole of the equinoctial.

The *latitude* of any object in the heavens is an arch of a circle of celestial longitude intercepted between the object and the ecliptic, and is called north or south, according as the object is north or south of the ecliptic.

The *longitude* of a celestial body is an arch of the ecliptic, intercepted between the first point of Aries and a circle of longitude passing through the centre of the object.

The *tropics* are two lesser circles parallel to the equinoctial, at about 23° 28′ distance from it, touching the ecliptic at the solstitial points: the northern tropic touches the ecliptic at the beginning of Cancer, and is thence called the *tropic of Cancer;* the southern tropic, touching the ecliptic at the beginning of Capricorn, is therefore called the *tropic of Capricorn.*

The *polar circles* are two lesser circles, about 23° 28′ distant from the poles of the equinoctial: that about the north pole is called the *arctic circle*, and the other the *antarctic circle.*

In order to illustrate the preceding definitions, let the circle Z H N O (Plate VII. Figure 3) represent the celestial meridian, Z the zenith, and N the nadir, of a place at A; *ho* the sensible horizon of the place, which may be considered as coinciding with H I O, the rational horizon, the north and south points being O and H, and the east and west points at I; and Z B N an azimuth or vertical circle, cutting the horizon in B; likewise let the line P *p* be the celestial axis, whose pole P is elevated above the rational horizon equal to the latitude of the place. Now, if V be considered as the place of a star in the heavens, V B will be its altitude, V Z its zenith distance, H B its azimuth from the south, or B O from the north. If the star be supposed to rise or set at F, the arch F I will be its amplitude from the east or west; and if the star be at G, on the meridian, G H will be its meridian altitude, and G Z its meridian zenith distance.

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* Excepting the newly-discovered Planets, or Asteroids—Vesta, Juno, Ceres, and Pallas.

Again, let P *p* represent the celestial axis, as before; the circle Z H N O, the solstitial colure; E Q the equinoctial, of which P*p* are the poles; P D *p* a circle of right ascension; ♋ ♑, the ecliptic; R *r* its poles; R L *r* a circle of longitude; ♋ ♋ the tropic of Cancer; ♑ ♑ the tropic of Capricorn; R M the arctic circle; and *rm* the antarctic circle. Then if V be the place of a star, V D will be its declination; V P or V *p* its polar distance; L V its latitude; and I L its longitude.

THE DIAMETER OF THE SUN, MOON, &c.

The apparent diameter of the sun, moon, &c. is the angle under which they appear to an observer situated on the earth; the quantity of which depends upon the real magnitude of the object, and its distance from the observer. Thus, let A B (Plate VII. Figure 4) represent the real diameter of a distant object, the eye being at C; then the angle A C B is its apparent diameter: now if the eye be removed further from the object, as to D, its apparent diameter will be the angle A D B, which is evidently less than the angle A C B; likewise if the real diameter be increased to E, its apparent diameter will likewise increase, for the angle E D B is greater than the angle A D B.

The sun's apparent semidiameter is set down in Page II. of each Month in the Nautical Almanac, for every day; but its mean semidiameter, which is 16′, is used in common practice, as it never deviates half a minute from that quantity. The moon's semidiameter varies considerably during her monthly revolution round the earth, and is set down for every 12th hour in Page III. of each Month in the Nautical Almanac. The apparent semidiameter there given is the angle under which it would be seen when in the horizon, or from the centre of the earth; but since the moon is nearer the observer, by a semidiameter of the earth, when in the zenith than when in the horizon, and as this difference bears a sensible proportion to the moon's distance from the earth's centre,* the semidiameter given in the Almanac is to be increased by a quantity, called the augmentation, depending on its altitude, which is contained in Table VII.

The distance of the sun from the earth being immense when compared with the earth's semidiameter, the augmentation of the sun's apparent semidiameter is therefore insensible. The apparent semidiameter of a planet is so small, that it is seldom noticed in calculations. The fixed stars have no sensible apparent magnitude, even when viewed through the most powerful telescopes.

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* The moon is about 60 semidiameters of the earth distant from the earth's centre.

DEPRESSION OF THE HORIZON.

The *depression*, or, as it is generally called, the *dip* of the horizon, is the angle contained between the sensible and apparent horizons, the angular point being the eye of the observer. Now as the altitudes of all celestial bodies observed at sea, are measured from the apparent horizon, which is below the sensible by a quantity depending on the height of the eye, these altitudes are greater when taken by a fore observation, and less when observed by a back observation, than they should be, by a quantity equal to the angle contained between the two horizons. Thus, let B A C (Plate VII. Figure 5) represent part of the surface of the earth, and A E the height of the observer's eye; then F E G will represent the sensible, and E H the apparent horizons; and therefore the angle F E H will be the depression, or dip, of the apparent below the sensible horizon. Let M be an object whose altitude is to be observed by bringing its image in contact with the apparent horizon; then will the angle M E H be the observed altitude, which is greater than the angle M E F, the altitude from the sensible horizon, by the angle F E H. In the back observation the observed altitude is M E L, to which the angle H E F, equal to G E K, must be added, to obtain the altitude above the sensible horizon F E.

The dip of the horizon is affected by terrestrial refraction, which, according to Dr. Maskelyne, amounts to $\frac{1}{10}$ the whole angle; but several astronomers differ in opinion respecting the quantity. In Table V. of this Work, which contains the dip answering to different heights of the observer, $\frac{1}{10}$ is allowed on the whole angle.

REFRACTION.

The rays of light which proceed from a celestial body on entering the atmosphere in an oblique direction, are bent out of their rectilinear course, and incline more and more towards the centre of the earth as they pass deeper into the atmosphere, and hence enter the eye of an observer in a different direction from that of the object, and make it appear higher than its real place. The difference between the real and apparent places of the heavenly bodies, as affected by the passage of the rays of light through the atmosphere, is called the *refraction* of the object. Let A B C (Plate VII. Figure 6) represent the surface of the earth, on which the observer stands at A, and D F F the surrounding atmosphere: now the rays of light which proceed from an object at Z in the zenith, falling perpendicularly on the atmosphere, are not refracted thereby, but continue in the same direction till they reach the eye of the observer. But if the rays proceed from a body not in the zenith, as at R, they fall on the atmosphere obliquely, and are bent or refracted into a curve inclining towards the earth's centre at T; and as the observer perceives objects in the direction that the rays proceeding from them enter the eye, he therefore imagines the body R to be at *r*; the difference of these places, or the arch R *r*, is the refraction of the object in altitude. Thus also if the rays from a star at *s* pass on to the eye by a curve-line D A, the observer judges that star to be in the direction of the side of this curve, terminating at the eye; that is, he conceives it to be at *s*, in the direction *s* A, touching the curve at the point A, where it enters the eye

The more obliquely the rays enter the atmosphere, the more they will be bent out of their rectilinear course, and hence the greater will be the refraction. The quantity of refraction likewise increases with the density of the atmosphere.

From what has been said, it follows that an object at the zenith is not subject to refraction; but that, as the distance from the zenith increases, the refraction becomes perceptible, and is proportionably greater as the body observed is further from the zenith, until it reaches the horizon, where the refraction is greatest. Also that, by the effect of refraction, the heavenly bodies appear more elevated above the horizon than they really are; and therefore the amount of refraction is to be subtracted from the apparent altitude of an object: in consequence of this, it likewise happens that the sun, stars, &c. may be actually below the horizon when they are seen above it; and hence they appear to rise sooner, and set later, than they would otherwise do.

PARALLAX.

We have already observed, that the sensible and rational horizons may be considered as coinciding, when extended to the sphere of the heavens. This assumption will lead us to no sensible error with respect to the stars, which are at such an immense distance from us, that the earth in comparison is, as it were, but a mere point; but with respect to the sun, moon, and planets, the earth's semidiameter must be taken into consideration, in deducing our conclusions from observations made upon those bodies.

The situation of a celestial body, when viewed from the surface of the earth, is called its *apparent place;* and that part of the heavens where it would be seen, if observed at the same time from the centre of the earth, is called its *true place.* The difference between the true and apparent places is termed the *parallax* of the object.

In order to illustrate the nature of parallax, let A H W (Plate VII. Figure 7) represent the earth, A the place of an observer on its surface, whose sensible horizon is *h o*, rational horizon H O, and zenith at Z; also let S G be part of a vertical circle, whose radius is the distance of the moon from the earth's centre; P *g* part of a vertical circle, whose radius is the distance of a planet from the earth's centre, and Z O a vertical circle in the sphere of the stars. Now, to a spectator at A, if the moon appear in R, its apparent place in the heavens will be at *a;* but if viewed from the centre T, its true place will be at the point B: the difference of these places, measured by the arch *a* B, is its *parallax in altitude*

But if the moon be in the sensible horizon at G, its apparent place will be at *o*, and its true place at D; the arch *o* D is called its *horizontal parallax.* Moreover, if *g* be the place of a planet in the horizon, the arch *o d* will be its horizontal parallax; and if its place be at *r*, the arch *a b* will be its parallax in altitude.

The parallax of an object is greatest at the horizon, and gradually diminishes as the body rises above the horizon, until it comes to the zenith, where the parallax vanishes. Thus o D and o d, the horizontal parallaxes of G and g, are greater than a B or a b, the parallaxes of R and r; and the objects at S or P, seen from A or T, will appear in the same place Z, or the zenith. The parallaxes of different objects are less or greater, as those objects are more or less distant from the earth. Thus the parallax o D of the moon G, is greater than the parallax o d of the planet g. It is likewise evident from the Figure, that the altitude of an object seen from the earth's surface, is less than it would be if seen from the centre; hence the parallax is to be added to the apparent altitude, in order to obtain the true altitude

The moon's parallax is greater than that of the other heavenly bodies, owing to its being nearer the earth; at the horizon it varies from about 61′ 32″ to 53′ 52″, and is set down in Page III. of each Month in the Nautical Almanac. The sun's mean horizontal parallax is $8\frac{3}{4}''$; that of the planets is variable, according to their distance from us in the different parts of their orbits.

TIME.

Time is a part of duration, and is measured by the motions of the heavenly bodies. It is divided into years, months, days, hours, &c.

A *day* is the interval between two successive transits of the sun, moon, or a star; and is denominated either a solar, lunar, or sidereal day, according to the name of that body to which it is referred.

A *sidereal day* is the interval between the transit of a star over a meridian, and its return to the same; and since the revolution of the earth on its axis is always performed in the same portion of time, the sidereal days will be of equal length. The day is divided into 24 sidereal hours, and these again are subdivided into sidereal minutes and seconds. The sidereal day commences when the first point of Aries passes the meridian, and continues until its return to the same. This mode of reckoning is used by Astronomers in their observatories, where there is generally a clock pointing out sidereal time, by which they ascertain the right ascensions of the heavenly bodies, as they pass the meridian of the place.

A *solar or apparent day* is the interval between the sun's departure from, and return to the same meridian. It is divided into 24 solar hours, and these again are subdivided into minutes and seconds: any portion of this day is called *true apparent or solar time*, and is that which is shewn by a sun-dial.

The length of the solar day being subject to continual variations on account of the eccentricity of the earth's orbit, and the obliquity of the ecliptic to the equinoctial, Astronomers, with the view of obtaining a convenient and uniform measure of time, have recourse to what they call a *mean solar day*, the length of which is equal to the mean, or average, of all the apparent solar days in a year, such as would be shewn by the sun if it moved always uniformly in the equinoctial: a clock, or chronometer, thus set, is said to be adjusted to *mean time.*

A mean solar day is longer than a sidereal one; for as the sun, in its apparent annual motion, advances in the ecliptic nearly a degree eastward every day, it will take more time than a fixed star to return to the same meridian; the mean solar day exceeding the sidereal day by 3m. 56. 55s of sidereal time.*

Since we can obtain only apparent time immediately from observations of the heavenly bodies, we must, in order to reduce this to mean time, apply a correction, called the *equation of time*, taken from Page I. of the given month in the Nautical Almanac, and applied as directed at the head of its column; but should we have occasion to reduce mean time to apparent time, then the equation is to be taken from Page II. of the Nautical Almanac, and applied as directed in that page.

Suppose, for example, it were required to find the time that should be shewn by a clock or chronometer, keeping mean time, on March 1st, 1866, at 3 hours after the sun has passed the meridian of Greenwich, that is, at 3 hours of apparent time, or what is generally called 3h. P.M.

In Page I. for the month of March in the Nautical Almanac, the equation of time, on the first day, is 12m.34s·63 at apparent noon, and the change in one hour, as shewn in the following column, is 0s·501.; this multiplied by 3, the number of hours since noon, gives 0s.503 † which being subtracted from 12m. 34 s.63, because the equation is decreasing, leaves 12m. 33s.13 for the reduced equation: now, add this quantity to 3 hours, the apparent time, as indicated at the top of the column, and the sum 3h. 12m. 33s.13 is the mean time which ought to be shewn by the chronometer when the solar or apparent time is 3 hours past noon on March 1st, at the meridian of Greenwich.

On the contrary, if on the same day, at 3 hours of Greenwich mean time, we required the corresponding apparent time, then 12m. 34s.74., the equation of time, taken from Page II. of the Nautical Almanac, and reduced as above, is to be subtracted from the mean time, 3 hours, and the remainder 2h. 47m. 26s.76 will be the corresponding apparent time at Greenwich.

Again, suppose it were required to find the mean time, on April 15th, 1866, corresponding to 10h. 8m. 30s. apparent time at Greenwich. Now, in this case the equation of time on the preceding apparent noon is, by Page I. of the month in the Nautical Almanac, 0m. 2s.03 *additive* to the apparent time; but on the following noon it is 0m. 12s.60 *subtractive;* for the equation first decreases to 0, and then increases; consequently the sum of the two equations, 14s.63, is the amount of the change in 24 hours; the difference for one hour, 0.617, multiplied by 10, the hours since noon at Greenwich, will give the product 6.17s., which being greater than 2 s.03., the equation at the preceding noon, the latter is to be subtracted from it, and the remainder 4s.14, will be the reduced equation of time, to be subtracted from 10h. 8m. 30s, the given apparent time at Greenwich,

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* A sidereal day is equivalent to 23h. 56m. 4. 09s. of mean time; and a mean solar day contains 24h. 3m. 56. 55s. of sidereal time.

† The correction for the daily change or variation of the equation of time, may be found sufficiently exact for the most practical purposes by Table LI.——See the Explanation of that Table.

(according to the precept at the head of the column); and the remainder 10h. 8m. 25s.86, will be the corresponding mean time at Greenwich.

A *lunar day* is the interval between the moon's passing a meridian and return to the same, its length being about 24h. 49m. of solar time: but the moon's motion in the heavens being very irregular, the lunar day is never employed as a measure of time.

There are three different modes of reckoning time with respect to the commencement of the day; these are denominated *civil*, *astronomical*, and *nautical*.

The *civil day*, which is that used by the generality of mankind, begins at midnight, and ends at the midnight following: it is divided into two parts of 12 hours each; the first are marked A. M., signifying *ante meridiem*, or before noon; and the latter twelve are marked P. M., signifying *post meridiem*, or afternoon.

The *astronomical day* commences twelve hours after the civil day, that is, at noon, and concludes at the following noon: it is generally reckoned through the 24 hours, from noon to noon; and what are by the civil, or common way of reckoning, called morning hours, are by Astronomers reckoned in succession from 12, or midnight, to 24 hours: for instance, 9 o'clock in the morning, July 3d, civil time, is July 2d at 21 hours astronomical time.

It thus appears that, from noon to midnight, the day of the month, and the hour of the day, are the same by both methods of reckoning; but from midnight to noon they differ; for at midnight, when the new civil day begins, the astronomical day of the same date will not commence till 12 hours after.

The *nautical* or *sea day* begins at noon, or 12 hours before the civil day, and ends at noon of the civil day; it is divided into two parts of 12 hours each, the former being marked P. M, and the latter A. M. This mode of reckoning arises from the custom of seamen dating their log for the preceding 24 hours, the same as the civil day; so that occurrences which happen, for instance, on Monday, 21st, afternoon, are entered in the log marked Tuesday, 22d. Hence the noon of the civil day, the beginning of the astronomical day, and the end of the nautical day, take place at the same moment.

Ships in the Royal Navy, and some merchantmen, date their log according to the civil mode of reckoning, calling the first 12 hours A. M., and the latter P. M., but make up the day's work as usual, from noon to noon, or at the middle of the civil day.

All the computations in the Nautical Almanac being made for astronomical time at the meridian of Greenwich, (the days commencing either at apparent or mean noon, as expressed at the top of the several pages), it will be necessary, before the quantities are reduced to the time of observation, to ascertain the corresponding time at Greenwich when the observation is taken. Now, by the diurnal revolution of the earth round its axis from West to East, all the heavenly bodies appear to move in a contrary direction, that is, from East to West, over 360° of longitude in 24 hours, which is at the rate of 15 degrees in one hour of time; consequently, at any place situated 15 degrees to the eastward of the meridian of Greenwich.

it will be noon at that place one hour before it is noon at Greenwich; but if the place be in 15 degrees of West longitude, it will be noon there one hour after it is noon at Greenwich, and in the same proportion for any other given longitude: hence we have the following rule for ascertaining the time at Greenwich corresponding to any given time under another meridian.

Rule. Reduce the given longitude into time by Table XIX., and add it to the astronomical time at the given place, if the longitude be West; but subtract it, if East; and the sum or remainder will be the corresponding Greenwich time.

In East longitude, when the longitude in time exceeds the time under the given meridian, add 24 hours to the latter, and subtract as before; then the remainder will be the time past noon of the preceding day.

In West longitude, when the sum of the longitude in time, and the time under the given meridian, exceeds 24 hours, take 24 hours from it, and the remainder will be the time past noon of the following day.

EXAMPLE I.

What will be the time at Greenwich, on October 5th, when it is 6 hours past noon, in longitude 45° 30′ West?

	h.	m.	
Time under the given meridian	6	0	
Longitude in time (XIX.)	3	2	West.
Corresponding time under the meridian of Greenwich	9	2	

EXAMPLE II.

Required the time at Greenwich, corresponding to July 21st, at 9h. 42m. 30s. A. M. (civil time), in longitude 76° 19′ East.

	h.	m.	s.	
Astronomical time under the given meridian, July 20th	21	42	30	
Longitude in time (XIX.)	5	5	16	East.
Astronomical time at Greenwich, July 20th	16	37	14	

EXAMPLE III.

February 15th, being in longitude 115° 36′ E., an observation was taken at 2h. 48m. 26s. P. M.; required the corresponding Greenwich time.

	h.	m.	s.	
Time of Observation at Ship, February 15th	2	48	26	
	24			
Ditto after noon, February 14th	26	48	26	
Longitude in time (XIX.)	7	42	24	East.
Greenwich time, February 14th	19	6	2	

EXAMPLE IV.

March 21st, at 6h. 46m. 17s. A. M. (civil time), in longitude 130° 40′ West: required the corresponding astronomical time at Greenwich.

	h.	m.	s.	
Astronomical time under the given meridian, March 20th.	18	46	17	
Longitude in time (XIX.)	8	42	40	W.
Astronomical time at Greenwich, since noon, March 20th...	27	28	57	
	24			
Ditto at Greenwich, March 21st	3	28	57	

EXAMPLE V.

November 12th, 1866, in longitude 49° 17′ W., at 4h. 46m. 17s. P. M., apparent time; required the mean time at Greenwich.

	h.	m.	s.	
Apparent time, in longitude 49° 17′ W	4	46	17	
Longitude in time (XIX.)	3	17	8	W.
Apparent time at Greenwich	8	3	25	
Reduced equation of time (Page I. Naut. Alm.)	—	15	40	
Mean time at Greenwich	7	47	45	

WINDS.

THE air, or atmosphere, which encompasses our terraqueous globe, and extends several miles above its surface, is by its elasticity capable of being expanded, or of spreading itself so as to fill up a larger space than it before occupied, and of being condensed or compressed into a less space. The principal causes in producing these effects are heat and cold; the former rarefying or expanding, and the latter condensing or compressing the air when, therefore, any portion of it becomes heated, the cooler or denser air from the neighbouring parts will acquire a motion towards the thinner, in order to restore the equilibrium, and thereby occasion those currents of air which are called *Winds.*

Although various causes may contribute to produce this inequality in the density of the atmosphere, yet the most general and permanent is the influence of the sun's rays, by which the air in the regions about the equator being heated to a greater degree, and consequently more rarefied than that which is nearer to either Poles, the more ponderous or dense air will have a motion from the north and south, in order to preserve the equilibrium; but as the sun is continually shifting to the westward, that part towards which the air tends, by reason of the rarefaction, is with him carried westward, and consequently the tendency of the whole body of air is that way, hence a general easterly wind is formed, which being impressed upon all the air of a vast ocean, the parts impel one another, and so keep moving till the next return of the sun, by which so much of the motion as was lost, is again restored, and thus the easterly wind is made perpetual: the combination of these two currents of air acting at the same time, will produce a north-easterly wind in the northern hemisphere, and a south-easterly wind in the southern hemisphere.

If the whole surface of the globe were sea, these winds would constantly blow quite round the world without interruption; but as water is of a more even temperature than land, the latter will sometimes be hotter and sometimes cooler than the former, rarefying or condensing to a greater degree the air immediately above, whereby the air will be put in motion, the denser towards the lighter, in order to restore the equilibrium: hence when a considerable body of land intervenes, particularly in the tropical regions, new points of rarefaction and condensation take place, sufficiently powerful to counteract the former more remote, and therefore more feeble cause; for it is to be observed, that the atmosphere derives a greater portion of its heat, near the surface, from its communication with land and water, than from the direct influence of the sun.

Partial and temporary winds are likewise frequently produced by thunder-storms, or other electrical phenomena. The rays of the sun are also sometimes obstructed by clouds, or mists in particular places; and one part of the world, or even of a particular country, will consequently be less heated than another: in that case there will always be a current of air from the cold to the warm region. Besides this, the falling of rain, or other circumstances, produce occasional alterations in the temperature of the air; and whenever these take place in any country, they must be attended with wind.

In those parts of the Atlantic and Pacific Oceans which are remote from the influence of the land, between the limits of about 28 or 30 degrees of north and south latitude, there is a constant easterly wind, the cause of which we have already assigned in the preceding observations. On the north side of the equator the wind blows from between the north and the east, and on the south side from between the south and the east, inclining more to the north and south as they are further from the equator: these winds are denominated the N. E. and S. E. *trade winds.*

But we are not to conclude that the above limits are without exception; for both their direction and extent vary much with the season of the year. When the sun approaches the tropic of Cancer, the S. E. trade-wind prevails further to the northward of the line, inclining more to the south than the east, and the N. E. trade-wind more to the eastward; on the contrary, when he is in Capricorn, the N. E. trade-wind extends more to the southward of the equator, but inclining more to the northward, and the S. E. veers a little more to the eastward.

The S. E. trade-wind generally extends as far as 5 or 6 degrees to the northward of the line, and sometimes even to 7 degrees, according to the seasons: sometimes the N. E. and S. E. trade-winds almost meet each other, leaving very little space between them; and at other times there will be an interval of several degrees subject to calms, squalls, thunder, lightning, and heavy rains. It has likewise been remarked, that between the trades, the wind frequently prevails from the S. W. quarter.

The trade-winds extend to higher degrees of latitude on the coasts of North and South America than on the coast of Africa, sometimes as far as 32 degrees on the North American coast, and to the same latitude south on the coast of Brazil; though they seldom exceed 28 degrees on the African side to the northward of the Cape of Good Hope.

Beyond the limits of the trade-winds, in both the northern and southern hemispheres, the winds are variable, but for the most part prevailing from the westward, or W. S. W. in the northern, and from the W. N. W. in the southern latitudes: these winds often extend to the Tropics, and sometimes even as far as the 20th degree of latitude.

The probable cause of the trade-winds thus changing to the opposite direction appears to be, that the rarefied air within the tropical regions being pressed upon by that which is cooler or denser, coming from the northward or southward, ascends to the upper part of the atmosphere, where the reflected rays of the sun has less influence, dispersing itself in order to maintain an equilibrium, and forming a contrary current at the commencement of the temperate zone, which produces the above-mentioned winds. But the above observation must be confined to particular seasons, within certain limits, and not be considered as invariably the case; for even in the South Atlantic Ocean, in those same parallels of latitude, the winds are light and variable, coming often from the S. E., and veering almost to every point of the compass.

The N. E. trade-wind in the Atlantic Ocean blows in a regular fresh gale at about 100 leagues from the coast of Africa; and it is remarked that, as ships approach nearer to the West Indies, this wind generally comes nearer to the east, so as seldom to deviate more than a point either to the northward or southward.

On the coast of Brazil the S. E. trade-wind is subject to periodical shiftings, according to the respective seasons: it blows there from N. E. to E. N. E. between September and March, and from S. S. E. to E. S. E from March to September.

On the African coast, from Cape Blanco to Sierra Leone, the winds (excepting always land-breezes and storms) blow from the north, inclining rather from the westward than from the eastward. From Sierra Leone to Cape Palmas the ordinary course of the winds is from W. N. W., and beyond Cape Palmas, as far down as about 28 degrees of south latitude, from S. W. to South, inclining more to the southward or westward, according to the particular situation or bearing of the shores and lands.

The reason of these dispositions of the trade-winds towards the land will appear obvious, from the general principles already laid down, when we consider the nature of the coasts, and their situation with regard to the sun. The vast Continent of Africa, for instance, being violently heated by the sun, especially those parts near the equator, the incumbent air will be exceedingly rarefied; and the sea being much cooler than the land, the current of air must almost constantly come from the westward, to restore the equilibrium; and it is to be observed, that the winds on the coast of Guinea actually acquire this direction towards the shore within 80 or 100 leagues, getting first more towards the south, then becoming full south, and afterwards shifting to the westward of the south. This part of the ocean is consequently much troubled with frequent calms, and with sudden and violent gusts of wind, known by the name of *Tornadoes*, which blow from all parts of the horizon.

In the Gulf of Guinea there is a periodical wind, called the *Harmattan*, which blows in a N. E. direction from the interior parts of Africa. The season in which it prevails, is during the months of December, January, and February; it comes on indiscriminately at any hour of the day, at any time of the tide, or at any period of the moon; and continues sometimes only a day or two, sometimes five or six days, and it has been known to last fifteen or sixteen days. There are generally three or four returns of it every season: it blows with a moderate force, but not quite so strong as the sea-breeze. It has been further observed, that between the 4th and 10th degree of north latitude, and between the longitude of Cape Verd and the easternmost of the Cape Verd Islands, there is a tract of sea which seems to be condemned to perpetual calms, attended with terrible thunders and lightnings, accompanied with such frequent rains, that this part of the sea is called the *rains*. This appears to originate from the same cause as those we have already stated; for this tract being placed in the middle, between the westerly winds blowing on the coast, and the easterly trade-wind blowing to the westward of it, the tendency of the air is here indifferent to either, and therefore keeps its place, and makes a calm; and the weight of the incumbent atmosphere being diminished by the continual contrary winds blowing from hence, is the reason that the air is not able to support the vapours plentifully raised here by the heat, but lets it fall in frequent and copious showers.

All these circumstances duly considered will account for those circuitous passages which ships make in sailing from one distant port to another in the Atlantic Ocean, and for the difficulty they meet with in sailing to the southward, especially in the months of July and August, when the S. E. trade-winds usually extend to 7 or 8 degrees north of the equator, and not unfrequently vary so much as to blow from the south, and even a point or two to the west of the south; for in this case every mile that is then obtained, must be in the face of a constant trade-wind, directly opposing the track of the ship, and by an infinite degree of trouble, and constantly plying to windward. For if, on the one hand, a ship steers W. S.W., and gets the trade-wind more towards the east, she will be in danger of falling in too soon with the coast and shoals of Brazil; and if she steers E. S. E., she must fall in with the coast of Guinea, and cannot extricate herself from that situation but by running down east to the Island of St. Thomas; it is for this reason that India ships, both outward and homeward bound, pass the equator in the Atlantic between the longitudes of 18° and 23° West: by keeping this course, they never fall in with the coast of America, either going to the Cape of Good Hope, or returning from it, and at the same time they avoid the calms on the coast of Africa.

These circumstances likewise point out the only possible course for ships to sail from the coast of Guinea for Europe; and that is, to steer away S.S E. or South, and with these courses to run off the shore, while the wind becomes more and more contrary. Though ships, when near the shore, can lie south on this coast, yet when they get more distant, they can only make good a S. E. course, and as they get further out, they will only make good an E.S.E. course; but they can generally make the Island of St. Thomas, or Cape Lopez, with these directions when they will find the winds to the eastward of the south. They then set off westerly from the coast, and run on till they come to 4 degrees south latitude, by which time they will find a constant trade-wind from the S. E.

On account of these general winds, ships bound from England, or other parts of Europe, to the West India Islands, or to the southern parts of the coast of North America, even as far to the northward as Virginia, consider it as most advantageous to get to the southward as soon as possible; for on their reaching the latitude of 30 degrees, or thereabouts, where they get within the influence of the trade-winds, they can depend on having a steady gale from the eastward, so as to enable them to run before the wind. For the same reason, all ships returning from the West Indies, or the contiguous part of the coast of North America, endeavour to run up to 30 degrees north latitude, or even further north, where they first find the wind begins to be variable, so as to enable them to make to the eastward. Indeed, the most general and prevailing wind, without the northern limits of the trade-wind in the Atlantic Ocean, is between the south and west, and therefore fair for bringing ships to Europe.

Again, ships bound to India from America run to the eastward in the variable winds, so as to be in the longitude of 35 or 38 degrees West when in the latitude of 30 degrees North; thence they steer south-easterly towards the Cape Verd Islands, passing two or three degrees to the westward of them. Being then in the general track of the European Indiamen, they steer south-easterly, to cross the equator between the longitude of 18 and 23 degrees West, where meeting the S.E. trade-wind, they must brace up, and sail upon a wind till they get so far to the southward as to meet with the variable winds, when they may steer to the eastward.

Between the parallels of 28 and 40 degrees of south latitude in the Indian Ocean, as we have already observed is the case in the South Atlantic, the wind is variable, but most frequently blows between the N.W. and S.W.; it is on this account that outward-bound East India ships generally run down their easting on the parallel of 36 degrees South.

From the latitude of 28 degrees South to the equator, the S.E. trade-wind blows constantly without any considerable interruption in the Indian Ocean, as in the Pacific and Atlantic, between some few degrees to the eastward of Madagascar, as far nearly as the Island of Java; but in the other parts of the Indian Ocean, and in the adjoining seas, the winds divide the year into two seasons, or *monsoons**, blowing certain months in one direction, and the rest of the year in the opposite.

In the Mozambique Channel, between the Island of Madagascar and the coast of Africa, the monsoons prevail alternately; the S.W. begins in

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* The word monsoon is derived from the Persian word *mousum*, which signifies season.

April, and continues till November: the N.E. then succeeds, and continues until April; but the S.W. monsoon in this channel is the fair season, and the wind sometimes varies towards the S.E. and E.S.E. on either coast, about the middle of November, where also there are in general regular land and sea breezes. The N.E. monsoon begins near the Comoro Islands and the north of Madagascar, but seldom extends beyond St. Augustine's Bay to the southward, towards which it commences only at the end of November.

To the north of the equator, in the whole extent of the seas comprised between the eastern coast of Africa, and the meridian which passes through the western part of Japan, the monsoons blow from the S.W. between the middle of April and the middle of October, and from the N.E. during the rest of the year, excepting only the Red Sea and the Gulf of Persia, which have particular winds; to which we might also add the Straits of Malacca, where the winds are generally shifting, and in which the monsoons do not blow for a long time.

In the Red Sea the winds blow almost nine months of the year from the southward, that is, from the end of August to the middle of May, and sometimes to the end of that month, when the wind changes to the North and N.N.W., and generally continues in that quarter to the end of August; but sometimes the land and sea breezes prevail.

In the Gulf of Persia the N.W. wind blows most part of the year, November, December, and January, being the only months when southerly winds are certain. These winds, however, are not so regular as those in the Red Sea, being often interrupted by fresh gales from the S.W., principally from Cape Mussendom, and sometimes by land-breezes.

In the Gulf of Siam, on the Coasts of Cambodia or Camboge, Cochin China, the Gulf of Tonquin, and China, the S.W. monsoon commences near the coast in the course of the month of April; but out at sea, in those parts, it does not change till a month later. It is for this reason that on the north part of Borneo, to the Islands of Palawan and Luconia, it is seldom known to blow constantly, but from the 1st to the 15th or 20th of May. As the S.W. monsoon continues only about six months, and commences near the coast, it there ceases first likewise, in the same manner, and is immediately succeeded by the N.E. monsoon. The winds in the China Seas are not so regular as in the Arabian Sea, and are frequently interrupted by violent and dangerous *tyfoons*.* These tyfoons are of the same nature with the hurricanes in the West Indies, both of which appear to arise from violent and sudden changes in the upper and lower regions of the air; and it has been remarked that they happen, for the most part, about the autumnal equinox, and are always preceded by calms and hot weather.

In that part of the Indian Ocean adjoining to New Holland, between the meridians of Sumatra and Java to the west, and New Guinea to the east, there is a regular monsoon, which sets in from the N.W. between the months of October and April; during the other months of the year the wind resumes its natural course of S.E. These winds are called the NW. and S.E. monsoons.

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* From the Chinese words *Ty*, great or powerful, and *Foong*, wind.

The monsoons do not change suddenly from one point of the compass to the opposite; between the expiration of one, and the commencement of the other, the winds are light and variable, and sometimes calms prevail, until the regular monsoon commences, and acquires sufficient strength to blow steady.

The shifting of the N.E. and S.W. monsoons is frequently attended with violent squalls; for which reason ships between the coasts of Malabar and Africa, if bound to Bombay from the southward, never attempt to make the former coast at the breaking up of the N.E. monsoon, particularly in the month of May; hence, likewise, they avoid the Coast of Coromandel in the month of October: for it is a fact worthy of remark, that the bad weather month on the Coast of Malabar is the fine weather month on the Coast of Coromandel, and *vice versâ*, although these coasts are situate on the same peninsula.

The most obvious cause of the above periodical changes in the wind appears to be the situation of the sun in the ecliptic at the different seasons of the year; for when the sun approaches the Tropic of Cancer, the soil of Persia, Bengal, China, and the adjoining countries, becomes so much more heated than the sea to the southward of those countries, that the current of the general N.E. trade-wind is interrupted, so as to blow at that season from the south to the north, contrary to what it would do if no land were there; but as the high mountains of Africa, during all the year, are extremely cold, the low countries of India to the eastward of it becomes hotter than Africa in summer, and the air is naturally drawn thence to the eastward: hence it is that the wind in those parts blows from the S.W. between April and October, contrary to the trade-winds in the Atlantic and Pacific Oceans in the same latitudes; but when the sun retires towards the Tropic of Capricorn, these northern parts become cooler, and the general trade-wind assumes its natural direction from the N.E.

Upon the same principle we account for the monsoons adjoining New Holland, which we find is an immense tract of land to the S.E. of the Sunda and Molucca Islands; for when the sun is in the Tropic of Cancer, the current of air, even independent of the trade-wind, will move from the S.E., to restore the equilibrium to the N.W.; on the contrary, in the months of November, December, and January, whilst the sun is nearly vertical over a great part of New Holland, the current of air, through the Sunda and Molucca Islands, will come from the N.W., to fill up the vacuum made by the rarefication, and thus occasion an alternate S.E. and N.W. monsoon.

The cause of *land* and *sea breezes*, which prevail principally between the Tropics, and never extend above three or four leagues from the shore, may be explained after the same manner as the monsoons. For during the day the sea is not so much heated by the presence of the sun as the land, nor is it so much cooled during the night; therefore, when the earth begins to be violently heated in the course of the day, the cooler air from the sea will rush in towards the land, to supply the deficiency occasioned by the greater rarefaction of the air; and hence arise the sea-breezes. On the other hand, the land becoming cooler than the water in the absence of the sun, the current of air, a few hours after sunset, flows from the land to the sea, and thus produces the land-breeze.

TIDES.

A TIDE is that regular motion of the waters of the ocean by which they rise and fall in certain intervals of time. The rising of the water is called the *flux*, or *flood;* and its falling, the *reflux*, or *ebb.* When the water has attained its greatest height, it is said to be *high water;* and when it is done falling, it is called *low water.*

These periodical motions of the waters are effected by the unequal attraction of the sun and moon, but chiefly that of the latter object, on the different parts of the earth. For the discovery of the laws by which this general principle of attraction is governed, we are indebted to the great Sir Isaac Newton, who has demonstrated that the power of attraction diminishes as the distance increases, in proportion to the squares of those distances.

Now it is evident by the above law, that those parts of the earth nearest the moon, are more attracted by her than the central parts; and that the central parts will be more attracted than those which are farthest from her: and therefore the distance between the earth's centre and the waters upon its surface, under and opposite to the moon, will be increased; so that if the earth's surface were covered with water, it would assume a spheroidal, or egg-like figure, the longest diameter of which would be directed to the moon's centre. Hence those parts of the earth directly under and opposite the moon, that is, where the moon is in the zenith and nadir, will have the flood, or high water, at the same time; while those parts at 90 degrees distance, or where the moon appears in the horizon, will have the ebb, or lowest water, at that time. As the moon apparently shifts her position from east to west, in going round the earth every day, the longest diameter of the spheroid following her motion, occasions two floods and ebbs, in about every 24 hours and 49 minutes, which is the length of a lunar day; or the interval between the moon's passing the meridian of any place, and returning to the same.

The earth's diameter bears a considerable proportion to its distance from the moon, but is next to nothing when compared to its distance from the sun; therefore the difference of the sun's attraction on the sides of the earth under and opposite to him, is much less than the difference of the moon's attraction on the sides of the earth under and opposite to her, and consequently the moon must raise the tides much higher than they can be raised by the sun.

From this theory, it may be thought the tides ought to be highest directly under and opposite the moon; but we find that in open seas.

where the water flows freely, the moon is generally past the meridian when it is high water. The reason is obvious; for though the moon's attraction were to cease altogether, when she was past the meridian, yet the motion of ascent communicated to the water before that time, would make it continue to rise for some time after; much more must it do so when the attraction is only something diminished.

The times of high water do not always answer to the same distance of the moon from the meridian at the same places; but are variously affected by the action of the sun, which brings them on sooner when the moon is in her first and third quarters, and keeps them back later when she is in her second and fourth; because, in the former case, the tide raised by the sun alone, would be earlier than the tide raised by the moon; and in the latter case, later.

When the moon is in *perigee*, or at her nearest distance from the earth, she attracts strongest, and therefore raises the tides most; the contrary happens when she is in *apogee*, or at her greatest distance from the earth, because of her weaker attraction At new moon, when the moon is in conjunction with the sun, the tides are raised by the joint attraction of both luminaries, and therefore will be highest; the same is the case at full moon, when the sun and moon are in opposition: for whilst the moon raises the tides under and opposite her, the sun acting in the same line, raises the tides under and opposite to him, whence their conjoint effect is the same as at the change, and in both cases occasions what are called *spring-tides*. But at the quarters, the sun raises the tides where the moon depresses them, and depresses them where they would be raised by the moon: hence it is the difference of their actions that produces the tides at the quarters, and these are called *neap-tides*. But these tides do not happen till a day or two after the above times; because in this, as in other cases, the effect is not greatest or least when the immediate influence of the cause is greatest or least, but some time afterward.

The sun being nearer the earth at the beginning than at any other time of the year, its attraction will then be most powerful; and of course about January the spring-tides will be greater than at any other time, and greatest of all if the moon at the same time should happen to be in perigee.

When the moon is in the equinoctial, the tides are equally high in both parts of the lunar day; but as the moon declines from the equinoctial towards either Pole, the tides are alternately higher and lower at places having north or south latitude. Whilst the moon has north declination, the greatest tides in the northern hemisphere are when she is above the horizon, and the reverse whilst her declination is south.

The tides rise higher at any place in proportion as the moon is nearer to the zenith or nadir of that place at the time of her passing the meridian; because the action of the moon is there strongest: hence the tides are greater between the Tropics than at any other parts, and less near the Poles.

All the above particulars would exactly obtain were the whole surface of the earth covered with deep water; but since there are multitudes of islands besides continents lying in the way of the tide, which interrupt its direct course, there arises a great variety of other appearances which require particular solutions, wherein the situation of the shores, straits, shoals, winds, and other things must be considered. For instance, as the sea has no known passage between Europe and Africa, let them be supposed one continent, extending from Weigate Straits, in latitude 78° North, to the Cape of Good Hope, in latitude 34° South; the middle of these two would be in about 19° North, near Cape Blanco on the west coast of Africa. But it is impossible the flood-tide should set to the westward upon the western coast of Africa (for the general tide, following the course of the moon, must set from east to west), because the continent for above 50 degrees, both northward and southward, bounds that sea on the east; therefore, if any regular tide, proceeding from the motion of the sea, from east to west, should reach this place, it must come either from the north of Europe southward, or from the south of Africa northward.

This opinion is further corroborated, or rather fully confirmed, by common experience, which shews that the flood sets to the southward along the west coast of Norway, from the North Cape to the Naze, or entrance of the Baltic Sea, and so proceeds to the southward along the east coast of Great Britain, and in its passage supplies all those ports which lie in its way, one after another. The coast of Scotland has the tide first, because it comes from the northward to the southward. On the full and change days it is high water at Aberdeen at 1h 0m., but at Tynemouth Bar not till 3h. 20m.; rising thence to the southward, it makes high water at the Spurn 26m. after 5h.; at Yarmouth Roads 15m after 9h.; at Harwich 12h. 6m.; at the Nore Light 30m. after 12h., and at London Bridge at 2h. 7m., all in the same day. And although this may seem to contradict the hypothesis of the natural motion of the tides being from east to west, yet as no tide can come west from the main continent of Norway or Holland, it is evident the tide we have been tracing, by its several stages from Scotland to London, is supplied by that tide, the original motion of which is from east to west. As water always inclines to its level, it will in its passage fall to any other point of the compass, to fill up vacancies where it finds them; and yet not contradict, but rather confirm the hypothesis.

From these circumstances it is evident, that the direct course of the rising tides from east to west being interrupted by the land lying in their way, they are often obliged to make a long circuit, and to flow in various directions; whence the setting of the tides, and the times of high water, are different at different places.

Lakes and inland seas, such as the Caspian Sea, the Mediterranean, and the Baltic Seas, have little or no sensible tides; for they are usually so small, that the attractive influence of the sun and moon is nearly equal at both extremities, and cannot therefore sensibly affect the water.

When the time of high water at any place is mentioned generally, it is to be understood of the time when it is high water at that place on the day of new or full moon; or the time past noon when it is high water on the day on which the sun and moon are together on the meridian of the place. Among pilots it is customary to reckon the time of flood, or high water, by the point of the compass the moon is supposed to bear on at that time, allowing three-quarters of an hour for each point. In places, for instance, where it is flood at noon on the days of full and change, the tide is said to flow north and south, or at 12 o'clock. In places where the moon is supposed to bear 1, 2, 3, 4, or more points to the east or west of the meridian, when it is high water on the same day, the tide is said to flow on such a point; so if the moon is supposed to bear S. E. at flood, it is said to flow S. E. and N. W., or 3 hours before the moon comes to the meridian, that is, at 9 o'clock; if she bears S. W., it flows S. W. and N. E., or at 3 hours after the southing; and in like manner for other points of the moon's bearing. But this absurd custom of reckoning the tides by the bearing of the moon, should be exploded, as founded in error; for the moon takes a greater or less portion of time in passing over any given number of points of the compass.

In some places it is high water on the shore, or by the ground, while the tide continues to flow in the stream or offing; and according to the length of time it flows longer in the stream than on the shore, it is said to flow tide, and such part of tide, allowing 6 hours to a tide. Thus 3 hours longer in the offing than on the shore make tide and half-tide; an hour and a half longer make tide and quarter-tide; three-quarters of an hour longer make tide and half-quarter-tide, &c.

The common method of finding the time of high water at any place is contained in the following particulars.

OF LEAP YEAR.

The length of the solar year being nearly 365 days 6 hours, and the common year containing only 365 days, one day is added every fourth year to the month of February, making that year contain 366 days, which is called *bissextile*, or *leap* year, and is found as follows

To find the Leap Year.

Rule. Divide the given year by 4, and if there be no remainder, it is leap year; but if 1, 2, or 3 remain, they shew that it is so many years after leap year.

Example. The year 1866, divided by 4, gives 466, and the remainder 2, which shews that it is the second year after leap year.

OF THE EPACT.

The Epact is the moon's age at the beginning of the year: it increases 11 every year, being the excess of the solar year of 365 days, above the lunar year of 354 days, or 12 lunations. It is also observed, that the moon goes through all her variety of aspects, with respect to the sun, in the course of 19 years; so that at the end of that period, which is called the *lunar cycle*, the new and full moons return on the same days of the month, and nearly at the same hours. Hence the following Rule:

To find the Epact.

Rule. Divide the given year by 19; multiply the remainder by 11, and the product will be the Epact, if it does not exceed 29; but if it does, divide the product by 30, and the last remainder will be the Epact.

Example. Required the Epact for the Year 1866.

1866, divided by 19, gives 98 for the quotient, and 4 for the remainder which multiplied by 11, gives 44; this, divided by 30, gives the quotient 1, and the remainder 14; which remainder is the Epact for the Year 1866.

OF THE NUMBER FOR THE MONTH.

The Number, or Epact for the Month, is the moon's age at the beginning of that month, when it is new moon on the 1st of January; hence,

To find the Number of any given Month.

Rule. Divide the number of days contained in the preceding months, reckoning from the beginning of January, by 29.5, or rather 29 53 (the period of a mean lunation in days and decimal parts), and the nearest whole number to the remainder is the Epact, or number for the Month required.

Example. Required the Number, or Epact, for September.

The days contained between the beginning of January and the beginning of September are 243; this number, divided by 29.53, gives the quotient 8, and the remainder 6.76, or 7 nearly, which is the Epact for September.

The Epacts, or Numbers for each Month, are as follow:

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
In common years	0	1	0	1	2	3	4	5	7	7	9	9
In leap years............	0	2	1	2	3	4	5	6	8	8	10	10

OF THE MOON'S AGE.

The moon's age is the number of days that has elapsed since the last change, or the new moon, and never exceeds 30.

To find the Moon's Age.

Rule. To the Epact of the Year add the Number for the Month, and the day of the month: the sum, if it does not exceed 30, is the moon's age; but if it does, subtract 30 from it, and the remainder will be the moon's age.

Example. Required the moon's age on July 17th, 1866.

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      19 ) 1866 ( 98               Epact for 1866 ................  14
           171                     Number for the Month ......       4
           ———                     Day of the Month ............    17
            156                                                     ——
            152                                                     35
            ———                                                     30
              4                                                     ——
             11                    The Moon's age ........ .....     5 Days.
            ———                                                     ——
      30 )  44 ( 1
            30
            ———
The Epact for 1866 = 14
                     ——
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ON THE MOON'S PASSAGE OVER THE MERIDIAN.

The moon passes the meridian of any place about 48 minutes, or four-fifths of an hour, later every day: now as the moon comes to the meridian with the sun on the day of new moon, the time that she comes to the meridian after the sun, on any day of her age, is easily found as follows.

To find the Time of the Moon's Passage over the Meridian.

Rule. Multiply the moon's age by 4, and divide the product by 5; the quotient will be the hours, and the remainder, multiplied by 12, the minutes, past noon, that the moon comes to the meridian. Or multiply the moon's age by 8, and point off the right-hand figure; then the left-hand figure or figures will be the hours, and the product of the right-hand figure by 6, the minutes, past noon of the moon's meridian passage. If the hours exceed 12, subtract that time from them, and the remainder will be the time of the moon's passage over the meridian after midnight.

Example I. Required the time of the moon's meridian passage, July 7th, 1866.

Epact for 1866	14
Number for the month	4
Day of the month	7
Moon's age	25 Days.

Moon's age	25 Days.
	4
	5) 100
	20 0
	12
Moon's passage over meridian	20h. 0m. P.M.

Example II. At what time will the moon pass the meridian, October 29th, 1866?

Epact for 1866	14
Number for the month	7
Day of the month	29
	50
	30
Moon's age	20 Days.

Moon's age	20 Days.
	.8
	16 0
	.6
Moon passes meridian	16h. 0m. P.M.
	12 0
Or	4h. 0m. A.M.

To find the Time of High Water at any Place on any given Day of the Moon's Age.

Rule. To the time of the moon's meridian passage on the given day, add the time of high water at the given place on the full and change days (taken from Table LVII); their sum is the time of high water at the place, past noon, on the given day. If this sum exceed 12 hours 24 minutes, which is about the interval between each succeeding tide, subtract 12 hours 24 minutes from it; or if it exceed 24 hours 48 minutes, subtract 24 hours 48 minutes from it, and the remainder will be the time of high water in the afternoon of the given day.*

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* It is to be observed that the above method gives the times of high water in *solar* or *apparent* time, to which therefore the equation of time (taken from Page I. of the Month in the Nautical Almanac), should be applied, to reduce them to *mean time.*—See Page 153.

Example I. Required the time of high water at London, June 20th, 1866.

Epact for 1866	14	Moon's age June 20th, 1866	8 Days
Number for June	4		4
Day of the month	20		—
	—		5) 32 (2
	38		
	30	Moon's meridian passage	6h 24m.
	—	Time at London (Table LVII)	2 7
Moon's age	8 Days		—
	—	High water at London	8 31 P. M.

Example II. At what time will it be high water in the Downs, September 24th, 1866?

Epact for 1866	14	Moon's age Sept. 24th, 1866	15 Days
Number for September	7		8
Day of the month	24		—
	—	Moon's meridian passage	12h. 0m.
	45	Time at Downs (Table LVII)	11 15
	30		—
	—		23 15
Moon's age	15 Days	Subtract the time of a tide =	12 24
	—		—
		High water in the Downs	10 51 P. M.

The preceding method of finding the time of high water, which is that usually practised at sea, is founded on the supposition that the interval between the moon's passing the meridian, and the time of high water, is always the same; but we have already observed, in the theory of the tides, that the sun brings on the tides sooner in the first and third quarters of the moon, and later in the second and fourth quarters, than if they were produced by the influence of the moon only: hence it will be subject to an error on this account; besides which, the moon's age, as above found, will frequently be more than a day, and the moon's meridian passage above an hour, wide of the truth. We have therefore given a more correct method with the aid of the Nautical Almanac, in which the moon's position with regard to the sun, her distance from the earth, the longitude of the place, and other particulars are taken into account. The result of this method will seldom deviate many minutes from the truth, unless when the tides are greatly influenced by the winds.

METHOD II.

Rule. Find the time of the moon's meridian passage, in *mean time*, on the given day, in Page IV. of the month in the Nautical Almanac, and reduce it to the time of her passing the meridian of the given place by Table XVI.; with this time, corrected by the equation of time to the *nearest minute*, taken from Page II. of the month in the Nautical Almanac, by addition or subtraction, as directed at the top of the column, and the moon's semidiameter from Page III. of the Nautical Almanac, take out the corresponding correction from Table XVI*, which add to, or subtract from, the above time, as directed in the Table, to the sum or remainder add the time of high water at the given place on full and change days

(Table LVII.), and the sum will be the time of high water, in *mean time*, past noon of the given day. But if the sum exceed 12h. 24m., or 24h. 48m., subtract those times from it, and the remainder will be the time of high water nearly, in the afternoon of the given day.

But should greater accuracy be required proceed thus:—

If the above sum be more than 12 hours, and less than 24 hours, the time of high water found as above, will be that on the following morning; in this case, therefore, to find it for the afternoon of the given day, diminish the moon's passage over the meridian of the ship by half the difference of the passages on the given and preceding days; then proceed as before, rejecting 12 hours from the result. Again, if the above sum be greater than 24 hours, it will be the time of high water after noon of the following day; when this is the case, diminish the moon's passage over the meridian of the ship, by the whole difference between the passages on the given and preceding days, and proceed as before, rejecting 24 hours from the result.

When the time of high water is found for the afternoon of the given day, the time of high water on the preceding morning may be found by subtracting 24 minutes from it; or, on the following morning, by adding 24 minutes to it.

Example I. Required the time of high water, in mean time at Falmouth, on October 15th, 1866.

	h.	m.
Moon's meridian passage, in mean time, by Page IV. Nautical Almanac	5	1
Correction for 5h. 1m. + Eq. of time 14m. = 5h. 15m., and moon's semidiameter 14′ 53″ (Table XVI.*)	1	3
	3	58
Time of high water at Falmouth, full and change days (Table LVI.)	4	57
Time of high water at Falmouth, in mean time, October 15th, 1866	8	55 P.M.

Example II. Required the time of high water, in mean time at Calcutta, in longitude 88° 27′ E., on January 28th, 1866.

	h.	m.
Moon's meridian passage, in mean time, at Greenwich, January 28th, by Page IV. Nautical Almanac	10	30
Correction to daily variation 56m.3, and long. 88° 27′ E. (Table XVI.)	−	13
Moon's meridian passage, in mean time at Calcutta	10	17
Correction to 10h. 17m. − Eq. of time 13m. = 10h. 4m., and moon's semidiameter at midnight 15′ 52″ (Table XVI*.)	+	25
	10	42
Time of high water at Calcutta, full and change days (Table LVII.)	2	30
	13	12
Average time of a tide	12	24
Time of high water at Calcutta, in mean time, January 28th, 1866	0	48 P.M.
	±	24
Time of high water at Calcutta, in mean time, *on the following morning*	1	12 A.M.
Time of high water at Calcutta, in mean time, *on the preceding morning*	0	24 A.M.

Example III. Required the time of high water, in mean time, at Halifax, in longitude 63° 34′ W., on August 5th, 1866.

	h.	m.
Moon's meridian passage, in mean time at Greenwich, August 5th, by page IV. Nautical Almanac	20	8
Correction to daily variation 58^m.4, and long. 63° 34′ W. (Table XVI.)	+	9
Time of moon's meridian passage, in mean time, at Halifax........	20	17
Correction to 20h. 17m. – Eq. of time, 6m. = 20h. 11m, and moon's semidiameter at noon on 6th, 16′ 14″ (Table XVI.*)........	+	12
	20	29
Time of high water at Halifax, full and change days (Table LVII.)	7	49
	28	18
Average time of two tides	24	48
Time of high water at Halifax, in mean time, August 5th, 1866........	3	30 P.M.

The last two Examples may be worked more correctly as follows:—

Example II. Required the time of high water, in mean time, at Calcutta, in longitude 88° 27′ E., on January 28th, 1866.

	h.	m.
Moon's meridian passage, in mean time, at Calcutta (as before)	10	17
Half difference of passages (56m.3) on the given and preceding days	–	28
	9	49
Correction to 9h. 49m. – Eq. of time 13m. = 9h. 36m. and moon's semidiameter at midnight 15′ 52″ (Table XVI.)*	+	29
	10	18
Time of high water at Calcutta, full and change days (Table LVII.)	2	30
	12	48
Subtract	12	0
Time of high water at Calcutta, mean time, January 28th, 1866	0	48 P.M.

Example III. Required the time of high water, in mean time, at Halifax, in longitude 63° 34′ W., on August 5th, 1866.

	h.	m.
Moon's meridian passage, in mean time, at Halifax, August 19th	20	17
Difference of passages on the given and preceding days (57m.8.)	–	58
Moon's meridian passage, in mean time, at Halifax, August 19th	19	19
Correction to 19h. 19m. – Eq. of time 6m. = 19h. 13m., and moon's semidiameter at noon, August 6th, 16′ 14″ (Table XVI.*)	–	27
	18	52
Time of high water at Halifax, full and change days (Table LVII.)	7	49
	26	41
Subtract	24	0
Time of high water at Halifax, mean time, August 5th, 1866	2	41 P.M.

Note.—In pages 494, 495, of the Nautical Almanac for 1866, the mean times of high water at London Bridge are given for every day throughout that year, and will serve to find the same at any place on the Coasts of Great Britain, Ireland, or other parts near the meridian of Greenwich, as explained in page 542 of that work.

EXAMPLES FOR EXERCISE.

Required the times of high water at the following places and times:—

1. At Botany Bay, in longitude 151° 16′ E., on 29th November, 1866.
Ans. By first method, 1h. 3m. P.M.; by last method, 1h. 18m. P.M.
2. At Boston, in longitude 71° 4′ W., on 11th April, 1866.
Ans. By first method, 7h. 27m. P.M.; by last method, 8h. 50m. P.M.
3. At Calcutta, in longitude 88° 27′ E., on 17th October, 1866.
Ans. By first method, 8h. 54m. P.M.; by last method, 8h. 10m. P.M.
4. At New York, in longitude 74° 3′ W., on 28th July, 1866.
Ans. By first method, 8h. 37m. P.M.; by last method, 8h 48m. P.M.
5. At Bombay, in longitude 72° 54′ E., on 27th December, 1866.
Ans. By first method, 2h. 52m. P.M.; by last method, 3h. 10m. P.M.
6. At Rio Janeiro, in longitude. 43° 16′ W., on 5th July, 1866.
Ans. By first method, 9h. 0m. P.M.; by last method, 8h. 18m. P.M.
7. At Trincomalé, in longitude 81° 21′ E., on 25th January, 1866.
Ans. By first method, 3h. 6m. P M.; by last method, 2h. 56m. P.M.
8. At Quebec, in longitude 71° 10′ W., on 10th June, 1866.
Ans. By first method, 3h. 26m. P.M.; by last method, 5h 2m. P.M

To find the Time of High Water at a given Place on the full and Change Days of the Moon, when the time of High Water is known at that Place on any other Day.

Rule. Reduce the time of the moon's meridian passage at Greenwich in *mean time*, found in Page IV. of the month in the Nautical Almanac, to the time of her passing over the meridian of the given place, by Table XVI.; to this time, corrected by the equation of time to the *nearest minute*, taken from Page II. of the month in the Nautical Almanac, by addition or subtraction, as directed at the top of the column, and apply the correction from Table XVI.*, then subtract the result from the observed time of high water in mean time on the given day; the remainder will be the time of high water at the given place, on full and change days.

But should the time to be subtracted be greater than the observed time of high water, from the time of the moon's meridian passage over the given place, subtract half the difference of two successive passages, and then proceed as before, adding 12 hours to the observed time of high water. Again, should the time to be subtracted be still the greater, take the whole difference of two successive passages from the time of the moon's passing the meridian of the place, and proceed as before, adding 24 hours to the observed time of high water.

Example I. Suppose that in the harbour of Rio Janeiro, in longitude 43° 16′ W., on the 20th of June, 1866, the time of high water should be at 8h. 54m. P.M.; required the time of high water on the full and change days of the moon.

	h.	m.
Moon's meridian passage, in mean time, at Greenwich, June 20th, by Page IV. of Nautical Almanac	6	34
Correction to daily variation $43^m.3$, and long. 43° 16′ W. (Table XVI.)	+	5
Moon's meridian passage, in mean time, Rio Janeiro	6	39
Correction to 6h. 39m. − Eq. of time 1m. = 6h. 38m., and moon's semi-diameter 14′ 57″ (Table XVI.*)	−	45
	5	54
Observed time of high water, in mean time	8	54
Time of high water at Rio Janeiro on full and change days	3	0 P.M.

Example II. Suppose that in the harbour of New York, in longitude 74° 3′ W., on the 2nd February, 1866, the time of high water should be at 9h. 57m. P.M.: required the time of high water on the full and change days.

	h.	m.
Moon's meridian passage, in mean time at Greenwich, February 2nd, by Page IV. of Nautical Almanac	14	38
Correction to Daily variation $43^m.9$, and long. 74° 3′ W. (Table XVI.)	+	8
Moon's meridian passage, in mean time, at New York	14	46
Half the difference (45m.) of passages, on given and preceding days	−	22
	14	24
Correction to 14h. 24m. − Eq. of time 14m. = 14h. 10m., and moon's semidiameter, at midnight, 15′ 7″ (Table XVI.*)	−	35
	13	49
Observed time of high water, in mean time, + 12 hours	21	57
Time of high water at New York on full and change days	8	8 P.M.

HADLEY'S QUADRANT.

It is generally allowed that we are indebted to John Hadley, Esq., for the invention, or at least the first public account of that admirable instrument, commonly called Hadley's Quadrant, who, in the year 1731, first communicated its principles to the Royal Society, which were by them published soon after in their Philosophical Transactions. Before this period the Cross Staff, and Davis's Quadrant, were the only instruments used for measuring altitudes at sea; both very imperfect, and liable to considerable error in rough weather; the superior excellence, however, of Hadley's Quadrant soon obtained its general use among seamen; and the many improvements this instrument has received from ingenious men at various times have rendered it so correct, that it is now applied, with the greatest success, to the important purposes of ascertaining both the latitude and longitude at sea.

Figure 1, Plate VIII. is a representation of Hadley's Quadrant; the principal parts of which are, the Octant, or Frame ABC; the Arch, or Limb BC; the Index D, the Nonius, or Vernier Scale, E; the Index Glass F; the Fore Horizon Glass G; the Back Horizon Glass H; the Shades, or Dark Glasses, I; and the Sight Vanes K and L.

The OCTANT, or FRAME, is generally made of ebony, or other hard wood, and consists of an arch firmly attached to two radii or bars AB, AC, which are strengthened and bound by the two braces M and N, in order to prevent it from warping.

The ARCH or LIMB, although only the eighth part of a circle, is, on account of the double reflection, divided into 90 degrees, numbered 0, 10, 20, 30, &c. from right towards the left; these are subdivided into 3 parts, containing each 20 minutes, which are again subdivided into single minutes, by means of the scale at the end of the Index. The arch extending from 0 towards the right-hand, is called the *arch of excess.*

The INDEX is a flat brass bar, that turns on the centre of the instrument. At the lower end of the index there is an oblong opening. To one side of this opening a nonius scale is fixed, to subdivide the divisions of the arch. At the bottom, or end of the index, there is a piece of brass which bends under the arch, carrying a spring, to make the nonius scale lie close to the divisions; it is also furnished with a screw, to fix the index in any desired position.

Some instruments have an *adjusting* or *tangent-screw* fitted to the index, that it may be moved more slowly, and with greater regularity and accuracy than by the hand: it is proper, however, to observe, that the index must be previously fixed near its right position by the above-mentioned screw, before the adjusting screw is put in motion.

The NONIUS is a scale fixed to the end of the index, for the purpose, as before observed, of dividing the subdivisions on the arch into minutes. It sometimes contains a space of 7 degrees, or 21 subdivisions of the limb, and is divided into 20 equal parts; hence each division on the nonius will be one-twentieth part greater, that is, one minute longer than the divisions on the arch; consequently, if the first division of the nonius, marked 0, be set precisely opposite to any degree, the relative position of the nonius and the arch must be altered one minute before the next division on the nonius will coincide with the next division on the arch. The second division will require a change of two minutes; the third of three minutes; and so on, till the 20th stroke on the nonius arrives at the next 20 minutes on the arch; the 0 on the nonius will then have moved exactly 20 minutes from the division whence it set out, and the intermediate divisions of each minute have been regularly pointed out by the divisions of the nonius.

The divisions of the nonius scale are in the above case reckoned from the middle towards the right, and from the left towards the middle; therefore the first 10 minutes are contained on the right of the 0, and the other 10 on the left. But this method of reckoning the divisions being found inconvenient, they are more generally counted, beginning from the right-hand towards the left; and then 20 divisions on the nonius are equal to 19 on the limb: consequently one division on the arch will exceed one on the nonius by one-twentieth part, that is, one minute.

The 0 on the nonius points out the entire degrees and odd twenty minutes subtended by the objects observed; and if it coincide with a division on the arch, points out the required angle: thus, suppose the 0 on the nonius stands at 25 degrees, then 25 degrees will be the measure of the angle observed; if it coincides with the next division on the left-hand, 25 degrees 20 minutes is the angle; if with the second division beyond 25 degrees, then the angle will be 25 degrees 40 minutes; and so on in every instance where the 0 on the nonius coincides with a division on the arch; but if it do not coincide, then look for a division on the nonius that stands directly opposite to one on the arch, and that division on the nonius gives the odd minutes to be added to that on the arch nearest the right-hand of the 0 on the nonius: for example—suppose the index division does not coincide with 25 degrees, but that the next division to it on the nonius is the first coincident division, then is the required angle 25 degrees 1 minute; if it had been the second division, the angle would have been 25 degrees 2 minutes, and so on to 20 minutes, when the 0 on the nonius would coincide with the first 20 minutes on the arch from 25 degrees. Again, let us suppose the 0 on the nonius to stand between 50 degrees and 50 degrees 20 minutes, and that the 15th division on the nonius coincides with a division on the arch, then is the angle 50 degrees 15 minutes. Further, let the 0 on the nonius stand between 45 degrees 20 minutes and 45 degrees 40 minutes, and at the same time the 14th division on the nonius stands directly opposite to a division on the arch, then will the angle be 45 degrees 34 minutes.

The INDEX GLASS is a plane speculum, or mirror of glass quicksilvered, set in a brass frame, and so placed that the face of it is perpendicular to the plane of the instrument, and immediately over the centre of motion of the index. This mirror being fixed to the index, moves along with it, and has its direction changed by the motion thereof.

This glass is designed to reflect the image of the sun, or any other object, upon either of the two horizon glasses, from whence it is reflected to the eye of the observer. The brass frame, with the glass, is fixed to the index by two screws at the back; the other screw S serves to place it in a perpendicular position, if by any accident it has been put out of order.

The HORIZON GLASSES are two small speculums on the radius A B of the frame; the surface of the upper one is parallel to the index-glass when the 0 on the nonius is at 0 on the arch; these mirrors receive the rays of the object reflected from the index-glass, and transmit them to the observer. The fore horizon-glass G is only silvered on its lower half, the upper half being transparent, in order that the direct object may be seen through it. The back horizon-glass H is silvered at both ends; in the middle there is a transparent slit, through which the horizon may be seen. Each of these glasses is set in a brass frame, to which there is an axis; this axis passes through the wood work, and is fitted to a lever on the under side of the quadrant, by which the glass may be turned a few degrees on its axis, in order to set the face of the fore horizon-glass parallel, or that of the back horizon-glass at right angles, to the index-glass.

To set the glasses perpendicular to the plane of the quadrant, there are two sunk screws, one before and one behind each glass: these screws pass through the plate on which the frame is fixed into another plate, so that by loosening one, and tightening the other of these screws, the direction of the frame, with its mirror, may be altered, and thus be set perpendicular to the plane of the instrument.

The Dark Glasses, or Shades, are used to prevent the bright rays of the sun, or glare of the moon, from hurting the eye at the time of observation. There are generally three of them, two red, and one green. They are each set in a brass frame which turns on a centre, so that they may be used separately or together, as the brightness of the object may require. The green glass may be used also alone, if the sun be very faint: it is likewise used in taking observations of the moon. When these glasses are used for the fore observation, they are fixed at I, as in Figure 1, but for the back observation, they are removed to O.

The Sight Vanes are pieces of brass, standing perpendicular to the plane of the instrument: that one which is opposite the fore horizon, is called *the fore sight vane*, the other *the back sight vane*. There are two holes in the fore sight vane, the lower of which, and the upper edge of the silvered part of the fore horizon-glass, are equidistant from the plane of the instrument, and the other is opposite to the middle of the transparent part of that glass; the back sight vane has only one hole, which is exactly opposite to the middle of the transparent slit in the horizon-glass to which it belongs.

ADJUSTMENTS OF HADLEY'S QUADRANT.

The several parts of the Quadrant being liable to be out of order, from a variety of accidental circumstances, it is necessary to examine and adjust them, so that the instrument may be put into a proper state previous to taking observations.

An instrument properly adjusted, must have the index-glass and horizon-glasses perpendicular to the plane of the Quadrant; the plane of the fore horizon-glass parallel, and that of the back horizon-glass perpendicular to the plane of the index-glass, when the 0 on the nonius is at 0 on the arch. hence the Quadrant requires five adjustments, the first three of which being once made, are not so liable as the last two to be out of order: however, they should all be occasionally examined, in case of accident.

I. *To set the Plane of the Index-Glass perpendicular to that of the Instrument.*

Place the index near to the middle of the arch, and holding the Quadrant in a horizontal position, with the index-glass close to the eye, look obliquely down the glass, in such a manner that you may see the arch of the Quadrant by direct view, and by reflection at the same time; if they join in one direct line, and the arch seen by reflection forms an exact plane, or strait line, with the arch seen by direct view, the glass is perpendicular to the plane of the Quadrant; if not, it must be restored to its right position by loosening the two sunken screws, and tightening the screw s, or *vice versâ*, by tightening the sunken screws, and releasing the screw s.

II. *To set the Fore Horizon-Glass parallel to the Index-Glass, the Index being at* 0.

Set the 0 on the nonius exactly against 0 on the arch, and fix it there by the screw at the under side. Then, holding the Quadrant vertically, with the arch lowermost, look through the sight-vane K, at the edge of the sea, or any other well-defined and distant object. Now, if the horizon in the silvered part exactly meet, and form one continued line with that seen through the unsilvered part, the horizon-glass is parallel to the index-glass. But if the horizons do not coincide, then loosen the button-screw in the middle of the lever, on the under side of the Quadrant, and move the horizon-glass on its axis, by turning the nut at the end of the adjusting lever, till you have made them perfectly coincide; then fix the lever firmly in this situation by tightening the button-screw. This adjustment ought to be repeated before and after every observation. Some observers adopt the following method, which is called finding the *index error:*—Let the horizon-glass remain fixed, and move the index till the image and object coincide; then observe whether 0 on the nonius agree with 0 on the arch; if it do not, the number of minutes by which they differ, is to be added to the observed altitude or angle, if the 0 on the nonius be to the right of the 0 on the arch; but if to the left of the 0 on the limb, it is to be subtracted.

It has already been observed, that that part of the arch beyond 0, towards the right hand, is called the arch of excess: the nonius, when the 0 on it is at that part, must be read the contrary way; or, which is the same thing, you may read off the minutes in the usual way, and then their complement to 20 minutes will be the real number, to be added to the degrees and minutes pointed out by the 0 on the nonius.

III. *To set the Fore Horizon-Glass perpendicular to the Plane of the Quadrant.*

Having previously made the above adjustment, incline the Quadrant on one side as much as possible, provided the horizon continues to be seen in both parts of the glass. If, when the instrument is thus inclined, the edge of the sea, seen through the lower hole of the sight-vane, continue to form one unbroken line, the horizon-glass is perfectly adjusted; but if the reflected horizon be separated from that seen by direct vision, the speculum is not perpendicular to the plane of the Quadrant: then if the limb of the Quadrant be inclined towards the horizon, with the face of the instrument upwards, and the reflected sea appear higher than the real sea, you must slacken the screw before the horizon-glass, and tighten that which is behind it; but if the reflected sea appear lower, the contrary must be performed. Care must be always taken in this adjustment, to loosen one screw before the other is screwed up, and to leave the adjusting screws tight, or so as to draw with a moderate force against each other.

This adjustment may be also made by the sun, moon, or a star: in this case the Quadrant is to be held in a vertical position; if the image seen by reflection, appear to the right or left of the object seen directly, then the glass must be adjusted, as before, by the two screws. This will be further explained in the use of the Sextant.

Some Quadrants have a vertical screw at the back of the instrument, by which the adjustment is made.

It will be necessary, after having made this adjustment, to examine if the horizon-glass still continue to be parallel to the index-glass; as sometimes, by turning the sunken screws, the plane of the horizon-glass will have its position altered.

IV. *To set the Back Horizon-Glass perpendicular to the Plane of the Index-Glass* 0 *on the Nonius being at* 0 *on the Arch.*

Let the 0 on the nonius be put as much to the right of 0 on the arch as twice the dip (taken from Table V.) amounts to: hold the Quadrant in a vertical position, and apply the eye to the back sight-vane L; then if the reflected horizon, which will appear inverted, or upside down, coincide with that seen direct, the glass is adjusted; otherwise the screw in the middle of the lever, on the under side of the Quadrant, must be slackened, and the nut at its extremity turned till both horizons coincide.

V. *To set the Back Horizon-Glass perpendicular to the Plane of the Quadrant.*

This adjustment is performed by holding the Quadrant nearly parallel to the horizon, and directing the sight through the back sight-vane; then, if the true and reflected horizons appear in the same strait line, the glass is perpendicular to the plane of the instrument; but if they do not coincide, turn the sunken screws in the pedestal of the glass, till both appear to form one strait line.

USE OF HADLEY'S QUADRANT.

The use of the Quadrant is to ascertain the angle subtended by two distant objects at the eye of the observer; but principally to observe the altitude of a celestial object above the horizon: this is pointed out by the index, when one of the objects seen by reflection, is made to coincide with the other, seen through the transparent part of the horizon-glass.

There are two different methods of observing altitudes with a Quadrant: one is when the observer's face is directed towards the celestial body, and it is brought down by reflection to that part of the horizon immediately under it; the altitude is in this case said to be taken by a *fore observation:* the other method is when the observer's back is towards the object, and it is brought over to the opposite part of the horizon, and is thence called a *back observation.* This latter method of observing is very seldom used, and is requisite only when the horizon under the object is broken by adjacent shores, or rendered indistinct by fogs, or any other impediments.

To take an Altitude of the Sun, Moon, or a Star, by a Fore Observation.

Having previously adjusted the instrument, place the 0 on the nonius opposite to 0 on the arch, and turn down one or more of the screens, according to the brightness of the sun; then apply the eye to the upper hole in the fore sight-vane, if the sun's image be very bright, otherwise to the lower, and holding the Quadrant vertically, look directly towards the sun, so as to let it be behind the silvered part of the horizon-glass, then the coloured sun's image will appear on the speculum. Move the index forwards till the sun's image, which will appear to descend, just touch the horizon with its lower or upper limb. If the upper hole be looked through, the sun's image must be made to appear in the middle of the transparent part of the horizon-glass; but if the lower hole, hold the Quadrant so that the sun's image may be bisected by the line joining the silvered and transparent parts of the horizon-glass.

The sun's limb ought to touch that part of the horizon immediately under the sun; but as this point cannot be exactly ascertained, it will therefore be necessary for the observer to give the Quadrant a slow motion from side to side, turning at the same time upon his heel, by which motion the sun will appear to sweep the horizon, and must be made just to touch it at the lowest part of the arch: the degrees and minutes then pointed out by the index on the limb of the Quadrant, will be the observed altitude of that limb which is brought in contact with the horizon.

In this manner the altitude of the moon, or a star, may be taken by a fore observation, remembering that when the moon is the object, her enlightened side is to be brought to the horizon, whether it be the upper or lower limb.

When the meridian, or greatest altitude, is required, the observation should be commenced a short time before the object comes to the meridian. Being brought down to the horizon, it will appear for a few minutes to rise slowly, when it is again to be made to coincide with the horizon, by moving the index forward: this must be repeated until the object begin to descend, when the index is to be secured, and the observation to be read off.

NOTE. For the methods of finding the time of the moon's, or a star's, passing the meridian, see the Explanation to Tables XVI, XLIII, and XLIV.

To take an Altitude of the Sun, Moon, or a Star, by a Back Observation.

Place the dark glasses in the hole near the back horizon-glass, and turn one or more of them down, according to the brightness of the sun; then, looking through the back sight-vane towards that part of the horizon opposite the sun, the Quadrant being held vertically, move the index till the sun's image be seen on the silvered part of the glass, and giving the Quadrant a slow vibratory motion, the sun will appear to describe an arch with its convex side upwards. Bring one of the limbs in contact with that part of the horizon seen through the transparent slit when it is in the upper part of this arch, and the degrees and minutes pointed out by the index, will be the altitude of the other limb; for in the back observation the image of the object is inverted. In the same manner, the altitude of the moon, or a star, may be taken, observing to bring the enlightened limb of the moon in contact with the horizon.

ON FINDING THE

LATITUDE BY OBSERVATION.

THE latitude of a place is its distance from the equator, either north or south, and is measured by an arch of a meridian contained between the zenith and the equinoctial: hence, if the distance of any heavenly body from the zenith when on the meridian, and its declination, or number of degrees and minutes it is to the northward or southward of the equinoctial, be given, the latitude may thence be found.

The meridian zenith distance of an object is found either from its altitude taken when on the meridian, or from one or two altitudes observed when out of the meridian.

Altitudes of the sun or moon taken at sea require four corrections, in order to obtain the true altitude of their centre: these are for semidiameter, dip, refraction, and parallax*. When the altitude of a star is observed, the corrections for dip and refraction only are to be applied. The parallax of the sun or a planet being but a few seconds, is seldom noticed in finding the latitude at sea.

To find the Latitude of a Place by the Meridian Altitude of the Sun.

Rule. From the observed altitude of the sun's limb (corrected for index error, if any), subtract the dip answering to the height of the eye above the horizon (found in Table V.), when the altitude is taken by a fore observation, or add it in a back observation, and the result will be the apparent altitude of the observed limb; from which subtract the refraction corresponding to that altitude (taken from Table IV.), and the remainder will be the true altitude of the observed limb.

When the sun's lower limb is observed, add the sun's semidiameter (16 minutes), but if the upper limb be observed, subtract it; and the sum, or remainder, will be the true altitude of the sun's centre†: or, when the altitude of the sun's lower limb is observed by a fore observation, the correction for the joint effect of the semidiameter, dip, refraction, and parallax, may be taken at once from Table IX.

Subtract the true altitude of the sun's centre from 90°, and the remainder will be the sun's true meridian zenith distance, which is to be called north or south, according as the observer, or his zenith, is north or south of the sun at the time of observation

Take the sun's declination from Table X., and reduce it to the meridian of the ship (when the longitude is considerable) by Table XI., noting whether it be north or south: then if the zenith distance, and declination, be both north, or both south, add them together; but if one be north, and the other south, subtract the less from the greater, and the sum, or difference, will be the latitude, of the same name with the greater

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* For an explanation of these corrections, see page 149, &c.

† Many seamen add 11 or 12 minutes to the observed altitude of the lower limb (being the difference between the semidiameter and the dip), and omit the correction for refraction altogether; but this neglect will frequently produce an error of several miles in the latitude, especially when the meridian altitude is small.

NOTE. If it be required to work the observation to seconds, the sun's semidiameter is to be taken from Page II. of the month in the Nautical Almanac; the declination for apparent noon at Greenwich, from Page I. of the same; and the latter reduced to noon at the meridian of the ship by Table XXI†. Take also the sun's correction in altitude, which is the difference of his refraction and parallax, from Table XVIII., instead of the refraction only, as shewn in Table IV. When the horizon under the sun is obstructed by land, the dip is to be taken from Table VIII.

EXAMPLE I.

June 18, 1866, the meridian altitude of the sun's lower limb was 43° 18′, the observer being North of the sun, and his eye elevated 18 feet above the surface of the sea: required the latitude of the place of observation, to the nearest minute.

	°	′
Obs. alt. of sun's lower limb	43	18
Dip of the horizon (Table V.) ...	—	4
App. alt. sun's lower limb	43	14
Refraction (Table IV.)	—	1
True alt. sun's lower limb	43	13
Sun's semidiameter	+	16
True alt. sun's centre	43	29
	90	
Sun's true zenith distance	46	31 N.
Sun's declination (Table X.)	23	25 N.
Latitude..................................	69	56 N.

EXAMPLE II.

September 21, 1866, in longitude 60° E., the meridian altitude of the sun's lower limb was 56° 26′, the observer being South of the sun, and the height of his eye 26 feet: required the latitude to the nearest minute.

	°	′
Obs. alt. sun's lower limb	56	26
Dip of the horizon (Table V.) ...	—	5
App. alt. sun's lower limb.........	56	21
Refraction (Table IV.)	—	1
True alt. sun's lower limb.........	56	20
Sun's semidiameter..................	+	16
True alt. sun's centre	56	36
	90	
Sun's true zenith distance...... ..	33	24 S.
Sun's declination (Tab. X.) 0°42′ Corr. for long. (Table XI.) + 4	0	46 N
Latitude	32	38 S.

EXAMPLE III.

January 9, 1866, in longitude 116° W., the meridian altitude of the sun's upper limb was 69° 14′ South, the observer being about 3 miles from the land, under the sun, and his eye elevated 22 feet: required the latitude to the nearest minute.

	°	′
Obs. alt. sun's upper limb	69	14 S.
Dip of the horizon (Table VIII.)..	—	5
App. alt. sun's upper limb	69	9
Refraction	—	0
True alt. sun's upper limb	69	9
Sun's semidiameter	—	16
True alt. sun's centre	68	53
	90	
Sun's true zenith distance	21	7 N.
Sun's declin. (Tab. X.)... 22° 6′ Corr. for long. (Table XI.) — 3	22	3 S.
Latitude..................................	0	56 S.

EXAMPLE IV.

December 25, 1866, in longitude 35° W., the meridian altitude of the sun's lower limb, by a back observation, was 16° 28′ South, the height of the eye being 20 feet: required the latitude to the nearest minute.

	°	′
Obs. alt. sun's lower limb	16	28 S.
Dip of the horizon	+	4
App. alt. sun's lower limb	16	32
Refraction	—	3
True alt. sun's lower limb	16	29
Sun's semidiameter	+	16
True alt. sun's centre	16	45
	90	
Sun's true zenith distance.........	73	15 N.
Sun's declin. (Tab. X.)...23°25′ Corr. for long. (Tab. XI.) — 0	23	25 S.
Latitude	49	50 N

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† Or more correctly by Table XXXIII.—See the Explanation to that Table.

EXAMPLE V.

May 29, 1866, in longitude 30° W., the meridian altitude of the SUN's lower limb was observed to be 65° 42′ 30″, the zenith being North of the sun, and the height of the eye 24 feet: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm......	21	37	44	N.
Corr. for long. 30° W. (Tab. XXI.)	+	0	49	
Sun's corrected declination	21	38	33	N.
Obs. alt. sun's lower limb.........	65	42	30	
Dip of the horizon	−	4	42	
App. alt. sun's lower limb	65	37	48	
Refr.—Parallax (Tab. XVIII.)	−	0	22	
True alt. sun's lower limb	65	37	26	
Sun's semidiameter by N. Alm..	+	15	49	
True alt. sun's centre	65	53	15	
	90			
Sun's true zenith distance	24	6	45	N.
Sun's corrected declination	21	38	33	N.
Latitude	45	45	18	N.

EXAMPLE VI.

November 21, 1866, in longitude 165° E., the meridian altitude of the SUN's lower limb was observed to be 47° 36′ 45″ S., the height of the eye being 18 feet: required the latitude.

	°	′	″	
Sun's declin. from Naut. Alm...	19	56	37	S.
Corr. for long. 165°E. (Tab. XXI.)	−	5	52	
Sun's corrected declination	19	50	45	S.
Obs. alt. sun's lower limb.........	47	36	45	S
Dip of the horizon	−	4	4	
App. alt. sun's lower limb	47	32	41	
Refr.—Parallax (Tab. XVIII.)	−	0	46	
True alt. sun's lower limb	47	31	55	
Sun's semidiameter by N. Alm.	+	16	14	
True alt. sun's centre	47	48	9	
	90			
Sun's true zenith distance	42	11	51	N.
Sun's corrected declination	19	50	45	S.
Latitude..............................	22	21	6	N.

EXAMPLE VII.

August 22, 1866, in longitude 8° West, the meridian altitude of the SUN's lower limb was 77° 49′ 30″, the observer being South of the sun, the height of his eye 30 feet, and the index error 1′ 30″ to be added[*]: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm.......	11	47	19	N.
Corr. for long. 8°W. (Tab. XXI.)	−	0	27	
Sun's corrected declination	11	46	52	N.
Obs. alt. sun's lower limb.........	77	49	30	
Index error to be added	+	1	30	
Corr. obs. alt. sun's lower limb...	77	51	0	
Corr. from Table IX. + 10′.2 =	+	10	12	
True alt. sun's centre	78	1	12	
	90			
Sun's zenith distance	11	58	48	S.
Sun's corrected declination	11	46	52	N.
Latitude..............................	0	11	56	S.

EXAMPLE VIII.

October 12, 1866, in longitude 30° E., the meridian altitude of the SUN's lower limb was 89° 54′ 30″ from the South point of the horizon, the height of the eye being 12 feet, and the index error 2′ 0″ to be subtracted[*]: required the latitude.

	°	′	″	
Sun's declin. by Naut. Alm......	7	25	1	S.
Corr. for long. 30°E. (Tab. XXI.)	−	1	52	
Sun's corrected declination	7	23	9	S.
Obs. alt. sun's lower limb.........	89	54	30	S.
Index error to be subtracted ...	−	2	0	
Corr. obs. alt. sun's lower limb...	89	52	30	
Corr. from Table IX. + 12′.7 =	+	12	42	
True alt. sun's centre	90	5	12	
	90			
Zenith distance	0	5	12	S.
Sun's corrected declination	7	23	9	S.
Latitude..............................	7	28	21	S.

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[*] When the horizon-glass of the Instrument has not been adjusted, so as to be parallel to the index-glass when 0 in the nonius is at 0 in the arch, the observed altitude is in all cases to be corrected for the *Index Error.*—See Description and Use of the Quadrant or Sextant.

EXAMPLES FOR EXERCISE.

1. January 15, 1866, in longitude 149° 50′ E., the meridian altitude of the Sun's upper limb was 33° 14′ 45″, the observer being North of the sun, the height of his eye 14 feet, and the error of the instrument 2′ 30″ to add: required the latitude.
Answer. 35° 52′ 51″ North.

2. December 3, 1866, in longitude 63° 18′ E., the meridian altitude of the Sun's lower limb was 64° 45′ 15″, North of the observer, the height of his eye being 20 feet, and index error 1′ 10″ to subtract: required the latitude.
Answer. 47° 10′ 21″ South.

3. August 30, 1866, in longitude 129° 15′ W., the meridian altitude of the Sun's lower limb was 57° 18′ 30″, the observer being North of the sun, the height of his eye 18 feet, and index error 0′ 45″ +: required the latitude.
Answer. 41° 21′ 59″ North.

4. March 20, 1866, in longitude 94° 45′ W., the meridian altitude of the Sun's lower limb was 89° 43′ 25″ South of the observer, the height of his eye being 12 feet, and the index error 2′ 20″ to add: required the latitude.
Answer. On the Equator.

5. September 23, 1866, in longitude 168° 10′ E., the meridian altitude of the Sun's lower limb was 84° 48′ 50″, the zenith being South of the sun, the height of the observer's eye 24 feet, and the index error 0′ 40″ to subtract: required the latitude.
Answer. 4° 54′ 33″ South.

6. March 10, 1866, in longitude 89° 30′ W., the meridian altitude of the Sun's lower limb was 14° 28′ 35″ S., the height of the eye being 30 feet, the distance of the land under the sun 1¼ miles, and the index error 1′ 15″ to add: required the latitude.
Answer. 71° 33′ 9″ North.

*To find the Latitude by the Meridian Altitude of a Star.**

Rule. Take out the star's declination from Table XIII., and reduce it to the time of observation. From the observed altitude of the star subtract the dip and refraction, taken from Tables V. and IV., (or subtract the correction taken from Table XV.,) and the remainder will be the star's true altitude, which subtracted from 90°, will give the zenith distance; to be called North or South, according as the observer is north or south, of the star at the time of observation.

Then, if the zenith distance and declination be both north, or both south, add them together; but if one be north, and the other south, subtract the less from the greater, and the sum, or difference, will be the latitude of the same name with the greater.

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* For the method of finding the time of a star's passing the meridian, see the Explanation to Table XLIV.; also the Explanation to Table XLVI., where directions are given for finding what star is on or near the meridian, and for observing its altitude.

EXAMPLE I.

January 24, 1866, about 8 o'clock in the evening, the meridian altitude of the star Aldebaran was 52°36′0″, the observer being North of the star, and the height of his eye 20 feet: required the latitude.

	°	′	″
Dec. of Aldebaran, Jan 1860 ...	16	13	28 N.
Ann. var. + 7″.67×6=46″.02=		+	46
Dec. of Aldebaran, Jan. 1866 ...	16	14	14 N.

	°	′	″
Obs. alt. of Aldebaran	52	36	0
Dip of horizon (Table V.)	−	4	17
App. alt. of Aldebaran	52	31	43
Refraction (Table IV.)............	−	0	43
True alt of Aldebaran............	52	31	0
	90		
Star's zenith distance	37	29	0 N.
Star's declination, Jan. 1866 ...	16	14	14 N.
Latitude	53	43	14 N.

EXAMPLE II.

July 16, 1866, about 3 o'clock in the morning, the meridian altitude of the star Fomalhaut was 73° 36′ 0″ South of the observer, the height of his eye being 24 feet, and index error 1′ 40″ to add: required the latitude.

	°	′	″
Dec. of Fomalhaut, Jan. 1860 ...	30	21	46 S.
An.var − 18″.96×6½=123″.24=	−	2	3
Dec of Fomalhaut, July, 1866...	30	19	43 S.

	°	′	″
Obs. alt. of Fomalhaut	73	36	0 S.
Index error to add	+	1	40
	73	37	40
Corr. from Table XV. − 4′.9=	−	4	54
True alt. of Fomalhaut............	73	32	46
	90		
Star's zenith distance	16	27	14 N.
Star's declination, July, 1866 ...	30	19	43 S.
Latitude............................	13	52	29 S.

EXAMPLES FOR EXERCISE.

1. April 6, 1866, at about 9h. P.M., the meridian altitude of the Star Regulus was 50° 14′ 20″ South of the observer, the height of his eye being 18 feet, and index error 1′ 15″ to add: required the latitude.
Answer. 52° 26′ 26″ North.

2. December 26, 1866, at about 0h 16m. A.M., the meridian altitude of the Star Sirius was 36° 28′ 30″, the observer being North of the star, the height of his eye 14 feet, and index error − 0′ 45″: required the latitude.
Answer. 37° 4′ 58″ North.

3. March 25, 1866, at about 4h. 16m. A.M., the meridian altitude of the Star Antares was 71° 49′ 45″ N., the height of the eye being 22 feet, and the index error of the instrument + 2′ 10″: required the latitude.
Answer. 44° 20′ 49″ South.

To find the Latitude by Meridian Altitude of a Planet.

Rule. From the observed altitude of the planet subtract the dip and refraction, and to the remainder add the parallax in altitude: the result will be the true altitude of the planet, which, subtracted from 90° will give the zenith distance, as before, and under this set the declination, reduced to Greenwich mean time*; then the sum, or difference of the zenith distance and declination, according as they are of the same or contrary name, will give the latitude, of the same name with the greater.

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* The Rule reducing the time at the place of observation, to the corresponding time at Greenwich, is given in page 155.

NOTE. The time of the meridian passage, together with the *geocentric* declination and other elements of the planets, are given for Greenwich mean time, in the Nautical Almanac for 1866, from Pages 252 to 300.* The declination is to be reduced to the time of observation at the meridian of Greenwich, by hourly variation as given in the Nautical Almanac for each planet respectively: or by Table XXXIII., as shewn in the Explanation of that Table.

The horizontal parallaxes of the planets for Greenwich mean noon, are contained in the Nautical Almanac for 1866, in Pages 302 to 323, from which the parallax in altitude is to be found by Table XLVIII.

EXAMPLE I.

November 13th, 1866, A.M at ship in longitude 109° 45′ E., suppose the meridian altitude of the planet MARS' to be 67° 47′ 40″, the observer being north of the planet, and the height of his eye 18 feet, with the index error 1′ 10″ to add: required the latitude.

In Page 277 of the Nautical Almanac, the mean time of the planet Mars' passage over the meridian of Greenwich, *on the preceding day*, is found to be 16h. 34m.;† and in Page 313, his horizontal parallax is 9″. 8.

	h.	m.		
Mean time at ship	16	34		Nov. 12
Long. 109° 45 in time (XIX)	7	19		E.
Mean time at Greenwich ...	9	15		Nov. 12
	°	′	″	
Dec. of Mars, Nov. 12	22	20	12	N.
Dec. of Mars, Nov. 13	22	19	49	N.
Var. of dec. in 24 hrs.		0	23	Log.1.7966
Greenwich mean time	9h.	15m.		Log.0.4141
	°	′	″	
Var.of dec.in 9h. 15m.	–	0	9	Log.2.2107
Dec. of Mars, Nov. 12	22	20	12	N.
Declin. at Greenwich mean time	22	20	3	N.

	°	′	″
Obs. meridian altitude of Mars,	67	47	40
Index error	+	1	10
Corr. meridian altitude of Mars	67	48	50
Dip of the horizon	–	4	4
	67	44	46
Refraction (IV. or XVIII.)		–	23
Apparent altitude of Mars	67	44	23
Parallax in altitude (XLVIII.)...		+	4
True altitude of Mars	67	44	27
	90		
True meridian zenith distance ...	22	15	33 N.
Declination at Greenwich time...	22	20	3 N.
Latitude	44	35	36 N.

EXAMPLE II.

August 12, 1866, in longitude 120° 30′ W., suppose the meridian altitude of the planet VENUS to be 76° 38′ 30″ S., the height of the observer's eye being 24 feet, with index error 1′ 25″ —: required the latitude.

In Page 266 of the Nautical Almanac, the mean time of the planet VENUS' passage over the meridian of Greenwich, *on the given day*, is found to be 2h. 39m. ; and in Page 309, her horizontal parallax is 8″.2.

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[*] For further explanation of the Ephemeris of the planets, *vide* Pages 531, 532, and 533 of the Nautical Almanac for 1866.

[†] The time of the planet's meridian passage, in the Nautical Almanac, being given to the meridian of Greenwich, it ought in strictness to be reduced to the time of its passage over the meridian of the place of observation ; but it will be sufficiently exact, for all nautical purposes, to take the time for *the astronomical day*, as predicted in the Almanac, the deviation being only *a few seconds* from the truth. If an observation be taken in the forenoon the astronomical date of the *preceding day* must be used.

	h.	m.		
Mean time at ship	2	39	Aug. 12.	
Long. 120° 30′ in time (XIX)	8	2	W.	
Mean time at Greenwich ...	10	41	Aug. 12.	
	°	′	″	
Dec. of Venus, Aug. 12	0	9	22	N.
Dec. of Venus, Aug. 13	0	21	26	S.
Var. of declin. in 24h.		30	48	
2)				
		15	24	Log. 0.1927
Greenwich mean time	10h.	41m.		Log. 0.3515
	°	′	″	
	0	6	51	Log. 0.5442
		×	2	
Variation in 10h. 41m.	–	13	42	
Dec. of Venus, Aug. 12	0	9	22	N.
Venus' dec. Green time	0	4	20	S.

	°	′	″	
Obs. meridian altitude of Venus	76	38	30	S.
Index error	–	1	25	
Corr. meridian altitude of Venus	76	37	5	
Dip of the horizon	–	4	42	
	76	32	23	
Refraction (IV. or XVIII)...		–	13	
Apparent altitude of Venus ...	76	32	10	
Parallax in altitude (XLVIII.)		+	2	
True altitude of Venus	76	32	12	
	90			
True meridian zenith distance...	13	27	48	N.
Declin of Venus at Green. time	0	4	20	S.
Latitude	13	23	28	N.

EXAMPLES FOR EXERCISE.

1. July 8, 1866, A.M., at ship in longitude 88° 30′ E., suppose the meridian altitude of the planet Mars to be 67° 44′ 35″ N., the height of the observer's eye 18 feet, and the index error of the sextant 1′ 20″ to add: required the latitude.

Answer. 5° 56′ 33″ S.

2. March 18, 1866, in longitude 98° 30′ W., suppose the meridian altitude of the planet Venus to be 50° 20′ 30″, the observer being south of the planet, and the height of his eye 20 feet, with index error of the sextant 1′ 10″ to subtract: required the latitude

Answer. 39° 43′ 3″ S.

To find the Latitude by the Meridian Altitude of the Moon.

Rule 1. In Page IV. of the month in the Nautical Almanac, find the mean time of the moon's passing the meridian of Greenwich *on the astronomical day*,* which reduce to the time of her passing the meridian of the ship by Table XVI.

2. With the above time, and the ship's longitude, find the corresponding Greenwich mean time, as directed in Page 155.

3. From Page III. of the month in the Nautical Almanac, take out the moon's semidiameter and horizontal parallax, and reduce them to the mean time at Greenwich;† and to the semidiameter add the moon's augmentation, taken from Table VII.

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* If the altitude be taken in the forenoon the meridian passage must be taken out for the preceding day.

† The moon's horizontal parallax and semidiameter are reduced to the time at Greenwich thus:—Take them out for the nearest noon or midnight before and after the Greenwich time, and find their difference; then say, for each, as 12 hours is to the difference in 12 hours, so is the Greenwich time since the preceding noon or midnight, to a proportional part; which being added to, or subtracted from, the horizontal parallax and semidiameter, at the preceding noon or midnight, according as they are increasing or decreasing, will give them reduced to the time of observation; or the proportional parts may be taken out by inspection from Table LV. But, in general, it will be sufficiently exact to take them out for the nearest noon or midnight, without applying the proportional parts.

4. From the observed altitude (corrected for index error, if any) subtract the dip of the horizon (Table V.), and to the remainder add the moon's augmented semidiameter, when the lower limb is observed; or subtract it if the upper limb be taken; the result will be the apparent altitude of the moon's centre.

5. From Table XXX. take out the correction answering to the moon's apparent altitude and horizontal parallax, and add it to the apparent altitude; the sum will be the true altitude of the moon's centre, which, subtracted from 90 degrees will give the zenith distance, to be called North or South, according as the observer is north or south of the moon: under this set the moon's declination, taken from Pages V. to XI. of the month in the Nautical Almanac, for the given day and hour at Greenwich, and reduced to the mean time at Greenwich, by Table XLVII.* Now the sum, or difference of the zenith distance and declination, according as they are of the same or contrary names, will give the latitude of the place of observation, of the same name with the greater.

EXAMPLE I.

May 21, 1866, in longitude 84° 45′ E., suppose the meridian altitude of the Moon's lower limb to be 68° 42′ 20″, the observer being north of the moon, and the height of his eye 24 feet: required the latitude.

	h. m.
Moon's mer. passage at Greenwich,	6 25
Daily var. 47m. 5, and long. 84° 45′ E.	– 11
Moon's merid. passage at the ship..	6 14
Long. of ship 84° 45′ in time (XIX.)	5 39 E.
Mean time at Greenwich May 21 ...	0 35

	° ′ ″	
☽'s dec. May 21, at 0h.	7 59 50 N.	(p. X. N. A.)
☽'s dec. May 21, at 1h.	7 50 42 N.	
Variation in 1 hour...	9 8	Log. 0.8175
Minutes after 0 hour,	35m. 0s.	Log. 0.2341
	° ′ ″	
Var. of dec. in 35 min.	– 5 20†	Log. 1.0516
☽'s dec. May 21, at 0h.	7 59 50 N.	
☽'s decline at Greenwich mean time...	7 54 30 N.	

In Page III. of May in the Naut. Almanac, the Moon's semidiam. at noon 21st, is 15′ 21″; and the horizontal parallax 56 15″. (Table LV.)

	° ′ ″
Obs. alt. moon's lower limb......	68 42 20
Dip of the horizon	– 4 42
App. alt. moon's lower limb ...	68 37 38
Moon's semidiam, + 15′ 21″ Augmentation (VII.) + 15	+ 15 36
App. altitude moon's centre ...	68 53 14
Cor. Tab. XXX. hor. par. 56′ 15″	+ 19 54
True altitude moon's centre ...	69 13 8
	90
Moon's true zenith distance ...	20 46 52 N.
Moon's dec. at Greenwich time	7 54 30 N.
Latitude	28 41 22 N.

EXAMPLE II.

November 27, 1866, A.M, at ship in longitude 56° 30′ W., suppose the meridian altitude of the Moon's upper limb to be 57° 45′ 50″, the observer being south of the moon, and the height of his eye 20 feet, with index error 1′ 15″ to subtract: required the latitude.

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* See the Explanation of this Table, with Examples.

† The variation or change in the moon's declination for the minutes past the given hour of Greenwich mean time, may be also found by multiplying the number noted in the Nautical Almanac, in the column headed "diff. dec. for 10m." opposite the declination for the preceding hour (placing the decimal point *one figure to the left* of that shewn in the N. A.) by the given number of minutes. Thus, 9″.117 × 35m. = 319″.095 = 5′ 19″ for the corr. in 35m.

	h. m.	
Moon's mer. passage at Greenwich...	16 24	
Daily var. 52 .1 & long. 56° 30′ W.	+ 8	
Moon's merid. passage at the ship ...	16 32	
Long. of ship 56° 30′ in time (XIX.)	3 46W.	
Mean time at Greenwich, Nov. 26...	20 18	
☽'s dec. Nov. 26, at20h.	13° 24′ 15″ N.	(pXI.N.A.)
☽'s dec Nov. 26, at21h.	13 16 38 N.	
Variation in 1 hour...	7 37	Log. 0. 8964
Minutes after 20 hours	18m. 0s.	Log. 0. 5229
Var. of dec. in 18 min.*	−° 2′ 17″	Log. 1. 4193
☽'s dec. Nov. 26, at 20h.	13 24 15 N.	
☽'s declin. at Greenwich mean time...	13 21 58 N.	

In page III. of November in the Nautical Almanac, the moon's semidiam. on the 26th at 20h. 18m. Greenwich time, is 15′ 58″, and the horizontal parallax 58′ 34″. (Table LV.)

	° ′ ″
Obs. alt. of moon's upper limb,	57 45 50
Index error to subtract	− 1 15
	57 44 35
Dip of the horizon	− 4 17
App. alt moon's upper limb......	57 40 18
Moon's semidiam. − 15′ 58″ Augmentation (VII.) + 14	− 16 12
App. alt. of moon's centre	57 24 6
Cor. Tab. XXX. hor. par. 58′ 34″	+ 30 57
True altitude of moon's centre,	57 55 3
	90
Moon's true zenith distance ...	32 4 57 S.
Moon's dec. at Greenwich time,	13 21 58 N.
Latitude	18 42 59 S.

EXAMPLE III.

August 13, 1866, in longitude 60° 30′ W., suppose the meridian altitude of the Moon's lower limb to be 77° 47′ 40″ S., the height of the observer's eye 12 feet, and the index error of the sextant 2′ 10″ to add · required the latitude.

	h m.	
Moon's mer. passage at Greenwich,	2 21	
Daily var. 45m.2 and long. 60° 30′ W.	+ 7	
Moon's merid. passage at the ship...	2 28	
Long. of ship 60° 30′ in time (XIX.)	4 2W.	
Mean time at Greenwich, Aug. 13	6 30	
☽'s dec. Aug. 13, at 6h.	0° 1′ 36″ N.	(pXI.N.A.)
☽'s dec. Aug. 13, at 7h.	0 8 21 S.	
Variation in 1 hour...	9 57	Log. 0. 7803
Minutes after 6 hours,	30m. 0s.	Log. 0. 3010
Var. of dec. in 30min.†	−° 4′ 59″	Log. 1. 0813
☽'s dec. Aug. 13, at 6h.	0 1 36 N.	
☽'s declin. at Greenwich mean time...	0 3 23 S.	

In Page III. of August in the Nautical Almanac, the moon's semidiam on the 13th, at 6h. 30m. Greenwich time is 15′ 16″, and the horizontal parallax 55′ 57″. (Table LV.)

	° ′ ″
Obs. alt. of moon's lower limb...	77 47 40 S.
Index error to add	+ 2 10
	77 49 50
Dip of the horizon	− 3 19
App. alt. of moon's lower limb...	77 46 31
Moon's semidiam. + 15′ 16″ Augmentation (VII.) + 15	+ 15 31
App. alt. of moon's centre	78 2 2
Cor. Tab. XXX. hor. par. 55′ 57″	+ 11 24
True altitude of moon's centre	78 13 26
	90
Moon's true zenith distance ...	11 46 34 N.
Moon's dec. at Greenwich time	0 3 23 S
Latitude	11 43 11 N.

---

* *Or, the pro. part of declin. may be found thus:* Var. of dec. in 1m. = 7″.587 × 18m = 136″.566 = 2′17″.

† *Or, the pro. part of declin. may be found thus:* Var. of dec. in 1m. = 9″.951 × 30m. = 298″.53 = 4′59″.

EXAMPLES FOR EXERCISE.

1. July 4, 1866, A.M.: at ship, in longitude 104° W., the meridian altitude of the Moon's lower limb was 57° 32′ 20″, the observer north of the moon, and the height of his eye 18 feet, with index error 1′ 20″ to add: required the latitude.

Answer. 31° 43′ 46″ North.

2. November 14, 1862, in longitude 137° 0′ E., the meridian altitude of the Moon's upper limb being 72° 48′ 50″ S., the height of the observer's eye 24 feet, and index error 1′ 15″ to subtract: required the latitude.

Answer. 2° 49′ 19″ North.

To find the Latitude by a Meridian Altitude below the Pole.

When the complement of the declination of an object is less than the latitude of a place, and they are both of the same name, the object comes to the opposite meridian without setting at that place, and in this case is said to be on the meridian below the pole; if the altitude be then taken, the latitude may thence be found as follows:—

Rule. Correct the declination and observed altitude, as before; then to the true altitude add the complement of the declination (found by subtracting the declination from 90°): the sum will be the latitude, of the same name with the declination.

EXAMPLE I.

June 28, 1866, in longitude 126° W., the meridian altitude of the Sun's lower limb, at midnight, was 6°30 15″, the height of the observer's eye being 20 feet: required the latitude.

	h.	m.
Apparent time at ship	12	0
Long 126° in time (Table XIX.)	8	24W.
Apparent time at Greenwich	20	24

	°	′	″
Sun's declin. June 28, at noon, (page 1 Nautical Almanac)	23	17	41 N.
Corr. for 20h. 24m. (Table XXI.)	−	2	50
Sun's declin. at Greenwich time	23	14	51 N.
	90		
Sun's Co. declination	66	45	9 N.

	°	′	″
Obs alt of sun's lower limb	6	30	15
Dip of the horizon	—	4	17
App alt. of sun's lower limb	6	25	58
Refr.—parallax (Table XVIII.)	−	7	47
True alt. of sun's lower limb	6	18	11
Sun's semidiameter	+	15	46
True altitude of sun's centre	6	33	57
Sun's Co. declination	66	45	9 N.
Latitude	73	19	6 N.

EXAMPLE II.

July 26, 1866, the altitude of the star Dubhe in Ursa Major, when on the meridian below the Pole, was 21° 14′ 0″, the height of the observer's eye being 16 feet, and the index error + 1′ 30″: required the latitude.

By Table XLIV. the time of Dubhe's passing the meridian above the Pole is 2h. 31m. P.M.; therefore 12h. after that time, or about 2h. 31m. A.M., it will be on the meridian below the Pole.

	°	′	″
Declin. of Dubhe, Jan. 1860	62	30	21 N.
An. var − 19″.35 × 6½ = 125″.77 =	−	2	6
Declin. of Dubhe, July 1862	62	28	15 N.
	90		
Star's Co. declination	27	31	45 N.

	°	′	″
Obs. altitude of Dubhe	21	14	0
Index error	+	1	30
	21	15	30
Dip of the horizon	−	3	50
App. altitude of Dubhe	21	11	40
Refraction	−	2	26
True altitude of Dubhe	21	9	14
Star's Co. declination	27	31	45 N.
Latitude	48	40	59 N.

EXAMPLES FOR EXERCISE.

1. July 13, 1866, in longitude 76° 30′ W., the altitude of the Sun's lower limb, when on the meridian below the Pole, was 8° 26′ 20″ S., the height of the observer's eye being 10 feet, and the index error + 3′ 15″ required the latitude.

Answer. 76° 51′ 49″ North.

2. August 22, 1866, at about 8h. A. M., the Star α in Crux being on the meridian below the Pole, its altitude was observed to be 17° 32′ 10″, the height of the observer's eye being 18 feet, and the index error − 2′ 25″: required the latitude.

Answer. 45° 1′ 9′ South.

To find the Latitude by an altitude of the Polar Star.

Rule. To the Sun's right ascension, taken from Table XIV., add the time since noon when the altitude was observed: their sum (rejecting 24 hours, if it exceed that quantity) will be the right ascension of the meridian, with which enter Table XVII., and add the corresponding correction to, or subtract it from, the star's true altitude, as directed in the Table: the sum, or remainder, will be the approximate latitude, to which *add* the correction, taken from Table XVII.*, and the sum will be the latitude, always North.†

EXAMPLE I.

May 21, 1866, in longitude 22° 25′ W., at 10h. 10m. P.M., mean time, suppose the alt. of the Polar Star to be 50° 18′ 10″, the height of the eye being 20 feet, and index error + 1′ 10″: required the latitude.

	h.	m.
Sun's right ascension, May 21....	3	51
Time of observation	10	10
Right ascension of meridian	14	1

	°	′	″
Obs. altitude of polar star	50	18	10
Index error to add	+	1	10
	50	19	20
Dip of horizon	−	4	17
	50	15	3
Refraction		−	47
Star's true altitude	50	14	16
Correction from Table XVII.	+1	22	0
Approximate latitude	51	36	16
Corr.fromTab.XVII.*+0′.2=		+	12
Latitude	51	36	28 N.
	°	′	″
†Lat. by Naut. Alm. method..	51	36	7 N.

EXAMPLE II.

January 16, 1866, in longitude 50° 15′ E., at 9h. 38m. P. M., mean time, suppose the altitude of the Polar Star (being corrected for index error, dip of the horizon, and refraction) to be 67° 30′ 22″: required the latitude.

	h.	m.	
Mean time at the ship	9	38	Jan. 16.
Long. of the ship 50° 15′ in time	3	21	E.
Mean time at Greenwich............	6	17	Jan. 16.

	h.	m.	s.
Sidereal time, mean noon, Greenwich, Jan. 16 (p. II. Naut. Alm.)	19	42	47
Mean time at the ship	9	38	0
Acceleration for 6h. 17m. (p. 502, N.A.) ..	+	1	2
Sidereal time of obs. (*subtract 24h.*)	5	21	49

	°	′	″
Star's corrected altitude (*as above*)	67	30	22
Subtract for correction	−	1	0
Star's reduced altitude..	67	29	22
First corr. for 5h. 22m. (p. 499, N.A.)..	−	38	8
	66	51	14
Second corr. for 5h. 22m. and alt. 67° 30′	+	1	58
Third corr. for 5h. 22m. Jan. 16	+	0	55
Latitude..........	66	54	7 N

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† In the Nautical Almanac for 1866, Rules and Tables are given for finding the latitude by an altitude of the Polar Star to the nearest second.—Vide pp. 542 and 543 with an Example.

The nearer the star is to the meridian, either above or below the Pole, when the observation is made, the less will be the error in latitude, arising from an error in the supposed time. The time of the star's passing the meridian may be easily obtained by consulting Table XLIV.; see also the Explanation to that Table.

EXAMPLES FOR EXERCISE.

1. September 6, 1866, in longitude 38° 30′ W., at 11h. 51m. P. M., mean time, suppose the altitude of the Polar Star to be 30° 30′ 25″, the height of the observer's eye being 22 feet, and the index error + 2′ 20″: required the latitude.

Answer. 29° 18″ 20′ North.—*By the N. A method*, 29° 17′ 3″ N.

2. March 11, 1866, in longitude 88° 30′ E., at 15h. 30m. past noon, mean time, suppose the altitude of the Polar Star to be 70° 26′ 30″, the height of the observer's eye being 18 feet: and index error − 1′ 30″: required the latitude.

Answer. 71° 37′ 17″ North.—*By the N. A. method*, 71° 37′ 41′ N.

To find the Latitude by two observed Altitudes of the Sun, and the Time elapsed between the Observations; having also the Latitude by Account, and the Sun's Declination when the greater altitude was taken.

Rule 1. To the log. secant of the latitude by account (XXV.), add the log. secant of the sun's declination; their sum, rejecting 20 from the index, call the *log. ratio.*

2. From the natural sine of the greater altitude (XXVI.) subtract the natural sine of the less altitude, and set the logarithm of their difference (XXIV.) under the log. ratio.

3. Take out the logarithms answering to half the elapsed time (XXVII.), and set it likewise under the log. ratio.

4. Add these three logarithms together, and find the middle time corresponding to their sum (XXVIII.), the difference between which and the half-elapsed time, will be the time from noon when the greater altitude was observed.*

5. From the log. rising, answering to this time (XXIX.), subtract the log. ratio, and the remainder will be the logarithm of a natural number (XXIV.); which being found, and added to the natural sine of the greater altitude, their sum will be the natural co-sine of the meridian zenith distance (XXVI.)

6. Having found the meridian zenith distance, apply to it the reduced declination, as directed in Page 180, and the result will be the latitude at the time of taking the greater altitude.

7. If the latitude thus found, should differ considerably from the latitude by account, the operation is to be repeated, using the computed latitude

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* When the middle time is greater than the half-elapsed time, both observations will be on the same side of the meridian; otherwise, on different sides.

instead of that by account, until the latitude last found agree nearly with the latitude used in the computation.*

Remarks on the Times of Observation.

As the above method is only an approximation to the truth, it must be used under the following restrictions, *viz*

The observations must be taken between nine o'clock in the forenoon and three in the afternoon. If both observations be in the forenoon, or both in the afternoon, the elapsed time must not be less than the time from noon when the greater altitude is taken. If one observation be taken in the forenoon, and the other in the afternoon, the elapsed time must not exceed four hours and a half; and in all cases, the nearer the greater altitude is to noon, the better.

If the sun's meridian zenith distance † be less than the latitude, the limitations are still more contracted. If the latitude be double the meridian zenith distance, the observations must be taken between half past nine in the forenoon, and half past two in the afternoon; and the interval, or elapsed time, must not exceed three hours and a half. The observations must be taken still nearer to noon, if the latitude exceed the meridian zenith distance in a greater proportion.

EXAMPLE I.

May 22, 1866, in latitude 41° 44′ N. by account, at 11h. 28m. in the forenoon, the true altitude of the sun's centre was 67° 16′, and at 0h. 24m. 40s. P. M. it was 68° 24′: required the true latitude.

Times.	Altitudes.	Nat. Sines.	Lat. by acc... 41° 44′...Secant	0.12712
11h. 28m. 0s. A. M.	67° 16′	92231	Declination... 20 24 ..Secant	0.02813
0 24 40 P. M.	68 24	92978		
			Log. ratio	0.15525
0 56 40		Diff. 747	Log.	2.87332
0 28 20 Half-elapsed time			Log.	0.90899
0 9 55 Middle time			Log.	3.93756
0 18 25 Time from noon			Log. rising	2.50879
			Log. ratio	0.15525
Natural number		226	Log.	2.35354
Natural sine of greater altitude		92978		

Nat. co. sine of mer. zen. dist....... 93204 = 21° 15′ N.
Declination 20 24 N.

Latitude... 41 39 N.

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* Dr. Brinkley, Professor of Astronomy in the University of Dublin, has published a Set of Rules for solving this Problem, which are annexed to the Nautical Almanac for the year 1822.

† The meridian zenith distance is equal to the sum of the latitude and declination, when they are of contrary names; or their difference, when of the same name.

EXAMPLE II.

August 9, 1866, in latitude 50° 39′ N. by account, at 11h. 36m. 29s. in the forenoon, the altitude of the sun's lower limb was 53° 18′; and at 1h. 13m. 53s. in the afternoon, its altitude was 51° 59′, the height of the observer's eye being 26 feet: required the true latitude.

	° ′ ″		° ′ ″
First obs. alt. of sun's lower limb...	53 18 0	Second obs. alt. of sun's lower limb.	51 59 0
Corr. from Table IX. + 10′.1 =...	+ 10 6	Corr. from Table IX. + 10′. 1 =	+ 10 6
True altitude of sun's centre	53 28 6	True altitude of sun's centre	52 9 6

Times. Altitudes. Nat. Sines. Lat. by acc. ...... 50°39′ ...Secant 0. 19787
12h. 0m. 0s. 53° 28′ .... 80351 Declination. ...... 15 52 ..Secant 0. 01687
11 36 29 A. M. 52 9 78962
Log. ratio 0. 21474
23 31 Diff. 1389 .... Log. 3. 14270
1 13 53 P. M.

1 37 24 Elapsed time
0 48 42 Half elapsed time .... Log. 0. 67592

0 12 23 Middle time .... Log. 4. 03336

0 36 19 Time from noon .... Log. rising 3. 09786
Log. ratio 0. 21474

Natural number......... 764 .... Log. 2. 88312
Natural sine of greater altitude ... 80351

Nat. co-sine of mer. zen. distance... 81115 = 35° 47′ N.
Declination 15 52 N.

Latitude... 51 39 N.

As the latitude resulting from this computation differs 61′ from the latitude by account, the operation must be repeated, using the latitude last found, instead of the latitude by account.

Latitude last found .... 51° 39′ ...Secant 0. 20728
Declination .... 15 52 ...Secant 0. 01687

Log. ratio 0. 22415
Difference of natural sines ....1389......................Log. 3. 14270
Half elapsed time........... 0h. 48m. 42s. ....Log. 0. 67592

Middle time .... 0 12 39 ....Log. 4. 04277

Time from noon .... 0 36 3 .... Log. rising... .... 3. 09148
Log. ratio 0. 22415

Natural number........... .... 737 ....Log. 2. 86733
Natural sine of greater altitude 80351

Nat. co-sine of mer. zen. distance......... 81088 = 35° 49′ N
Declination 15 52 N

Latitude... 51 41 N.

As this latitude differs only two miles from the latitude by the first operation, it may therefore be esteemed the true latitude.

In the preceding examples both observations were supposed to be taken in the same place; but as this is seldom the case, it will be necessary, when the ship is making much way, and the elapsed time is considerable, to *correct the less altitude*, in order to find what it would have been, had it been taken at the place where the greater altitude was observed; which is to be done as follows:

Let the bearing of the sun be observed by compass, at the time of taking the *less altitude*, and find the number of points contained between that and the ship's course by compass, between the observations, corrected for lee-way, if she make any, which subtract from 16, when it is more than 8 points; likewise compute the distance run during the elapsed time: with these enter Table I., and find the corresponding difference of latitude, which will be the correction for the change of station.

If the *less altitude* be observed in the *forenoon*, the correction is to be added to it, if the above angle be less than 8 points; but when it is more, to be subtracted.

If the *less altitude* be observed in the *afternoon*, the correction is to be subtracted, if the angle be less than 8 points; but when greater, it is to be added to the less altitude.

The less altitude being thus corrected, proceed according to the Rule, and the result will be the latitude of the ship when the greater altitude was observed: and the nearer the latter is taken to noon, the better.

EXAMPLE III.

November 10, 1866, latitude by account 32° 32′ N., at 9h. 30m. A.M. the altitude of the sun's *lower limb* was 28° 14′, the bearing of its centre by compass being S. E. ½ E.; and at 11h. 17m. 42s. A. M. the altitude of the *upper limb* was 39° 8′; the height of the observer's eye being 18 feet, and the ship's course between the observations S. by E., running 7 knots per hour; required the latitude of the ship at the time of the latter observation.

The elapsed time between the observations is nearly 1 hour 48 minutes, and her rate of sailing 7 miles per hour; therefore, as 1 hour : 7 miles : : 1h. 48m. : 12 miles, the distance run between the observations.

Sun's bearing at first observation, S. E. ½ E. or S. 4½ Pts. E.
Ship's course during the elapsed time, S. by E. or S. 1 Pt. E.

Angle between them.. ... 3½ Pts. which being taken as a course, in Table I, and the distance run during the elapsed time 12 miles, as a distance, given in the latitude column 9.3 miles nearly, to be added to the less altitude, according to the above rule.

	°	′	″		°	′	″
Obs. alt. of sun's *lower limb*.........	28	14	0	Obs. alt of sun's *upper limb*.........	39	8	0
Dip. of the horizon	−	4	4	Dip. of the horizon......................	−	4	4
	28	9	56		39	3	56
Refraction—parallax	−	1	38	Refraction—parallax..................	−	1	3
	28	8	18		39	2	53
Semidiameter from N.A............	+	16	12	Semidiameter from N.A.	−	16	12
True altitude of sun's centre	28	24	30	True altitude of sun's centre	38	46	41
Corr. for ship's way +9′. 3 =......	+	9	18				
Sun's *corrected* altitude	28	33	48				

Times by Watch.		True Alts.	Nat. Sines.		
9h. 30m. 0s.	A. M.	28° 34′	47818	Lat. by acc. 32° 32′ …Secant	0.07413
11 17 42	A. M.	38 47	62638	Declination. 17 10 …Secant	0.01979
				Log. ratio	0.09392
1 47 42	Elapsed time.		Diff. 14820	Log.	4.17085
0 53 51	Half-elapsed time			Log.	0.63299
1 33 6	Middle time			Log.	4.89776
0 39 15	Time from noon			Log. rising	3.16522
				Log. ratio	0.09392
	Natural number		1178	Log.	3.07130
	Natural sine of greater altitude		62638		
	Nat. co-sine of mer. zen. dist.		63816 = 50° 21′ N.		
	Declination		17 10 S.	Secant	0.01979
	Latitude		33 11 N.	Secant	0.07731

h. m. s.				
			Log. ratio	0.09710
	Diff. nat. sines	14820	Log.	4.17085
0 53 51	Half-elapsed time		Log.	0.63299
1 33 49	Middle time		Log.	4.90094
0 39 58	Time from noon		Log. rising	3.18098
			Log. ratio	0.09710
	Natural number	1213	Log.	3.08388
	Natural sine of greater altitude	62638		
	Nat. co-sine of mer. zen. dist.	63851 = 50° 19′ N.		
	Declination	17 10 S.		
	Latitude	33 9 N.		

EXAMPLE IV.

September 8, 1866, in latitude, 60° 10′ S. by account, and longitude 179° 45′ E., the altitude of the sun's lower limb was observed to be 19° 42′ at 10h. 4m. 20s. apparent time in the *forenoon*, his centre bearing N.N.E. by compass, and at 1h. 32m. 36s. *afternoon*, it was 21° 8′ 10″. The ship's course during the elapsed time was S.W. by S., sailing at the rate of 9 knots per hour, and the height of the observer's eye 16 feet: required the latitude of the ship at the time of taking the greater altitude.

	h. m. h.		° ′ ″
App. time at ship *at greater alt.*	1 33+24	Sun's dec. Sept. 7, by p. I. N.A.	6 4 7 N.
Long. 179° 45′ in time (XIX.)	11 59 E.	Corr. for 13h. 34m. (XXI.)	− 12 57
Greenwich apparent time	13 34 Sept. 7.	Sun's dec. at Greenwich time	5 51 10 N

Sun's bearing, when the *least alt.* was obs., N. N. E =	N. 2 Pts. E.
Ship's course during the elapsed time was S.W. by S. =	N. 13 Pts. W.
Angle between the ship's course and sun's bearing	15 Points.
	16
To be taken out as a course	1 Point.

The elapsed time between the observations is nearly 3h. 28m., and her rate of sailing 9 miles an hour: then say, as 1h. : 9m :: 3h. 28m. : 31m. distance run, which, in diff. lat. column give 30. 4m. to *sub.* from the *less alt.* as directed opposite.

	° ′ ″		° ′ ″
First obs. alt. of sun's lower limb...	19 42 0	Second obs. alt. of sun's lower limb.	21 8 10
Corr. from Table IX. + 9′.5 =...	+ 9 30	Corr. from Table IX. + 9′. 6 =...	+ 9 36
True altitude of sun's centre	19 51 30	True altitude of sun's centre	21 17 36
Corr. for ship's way − 30′. 4 =......	− 30 24		
Sun's *corrected* altitude	19 21 6		

Times by Watch.	True alts.	Nat. Sines.		
			Lat. by acc. ...... 60° 10′ ...Secant	0. 30323
12h. 0m. 0s.	19° 21′	33134	Declination. ...... 5 51 ...Secant	0. 00227
10 4 20 A. M.	21 18	36325		
			Log. ratio	0. 30550
1 55 40		Diff. 3191.........................	Log.	3. 50393
1 32 36 P. M.				
3 28 16 Elapsed time				
1 44 8 Half elapsed time			Log.	0. 35763
0 16 51 Middle time..			Log.	4. 16706
1 27 17 Time from noon......................................			Log. rising....................	3. 85521
			Log. ratio	0. 30550
Natural number.........		3545	Log.	3. 54971
Natural sine of greater altitude ...		36325		
Nat. co-sine of mer. zen. distance...		39870=66° 30′ S.		
	Declination	5 51 N.	Secant	0. 00227
	Latitude ...	60 39 S.	Secant	0. 30968
			Log. ratio	0. 31195
h. m. s.	Diff. nat. sines 3191	....	Log.	3. 50393
1 44 2 Half elapsed time........................		....	Log.	0. 35763
0 17 6 Middle time			Log.	4. 17351
1 27 2 Time from noon			Log. rising....................	3. 85275
			Log. ratio	0. 31195
Natural number		3473	Log.	3. 54070
Natural sine of greater altitude		36325		
Nat. co-sine of mer. zen. distance......		39798 = 66° 33′ S.		
	Declination	5 51 N.		
	Latitude ...	60 42 S.		

EXAMPLE V.

May 6th, 1866, in latitude 29° 10′ S., and longitude by account 52° 0′ W. at 9h. 49m. 20s. by a chronometer*, the observed altitude of the sun's *upper limb* was 45° 33′; and at 10h. 44m. 45s by the same chronometer, the observed altitude of his lower limb was 42° 8′ 40″, at which time it bore N. ¼ E. by compass. The ship's course between the observations was

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* The chronometer is here used, for the purpose of measuring the elasped time *more accurately* than by a common watch.

N. W. ¼ N. on the starboard tack, running at the rate of 6 knots per hour, and making 1 point lee-way, the height of the observer's eye being 22 feet, and the apparent time at the meridian of the ship, when the greater altitude was observed, about 1h. 20m. P. M. required the latitude of the ship when the greater altitude was taken.

	h.	m.			°	′	″	
App. time at ship *at great. alt.*	1	20	May 6.	Sun's declin., May 6, by N. A.	16	32	54	N
Long. 52° 00′ in time (XIX.)...	3	28	W.	Corr. for 4h. 48m (XXI.)......	+	3	25	
Greenwich apparent time	4	48	May 6.	Sun's dec. at Greenwich time..	16	36	19	N.

The ship's course N. W. ¼ N. corrected for 1 point leeway is N. W. ¾ W=N.	4¾ Pts. W.
The sun's bearing at the time of observing the *lesser altitude* was............N.	¼ Pt. E.
Angle between the ship's course and sun's bearing is	5 Points.

Distance run during the elapsed time 6m. give in the latitude column 3.3 miles, to be subtracted from the *less altitude*, as directed in page 194.

	°	′	″
Obs. alt. of sun's *upper limb*.........	45	33	0
Dip of the horizon	—	4	30
App. alt. of sun's upper limb	45	28	30
Refraction	—		56
True alt. of sun's upper limb	45	27	34
Sun's semidiameter by N. A.	—	15	53
True altitude of sun's centre	45	11	41

	°	′	″
Obs. alt. of sun's *lower limb*.........	42	8	40
Dip. of the horizon	—	4	30
App. alt. of sun's lower limb	42	4	10
Refraction	—	1	3
True alt. of sun's lower limb	42	3	7
Sun's semidiameter by N. A.	+	15	53
True altitude of sun's centre	42	19	0
Corr. for ship's way −3′.3 = ...	—	3	18
Sun's *corrected* altitude...............	42	15	42

Times by Chron.				True Alts.		Nat. Sines.	Lat. by acc. ... 29° 10′ ...Secant	0.05888
9h.	49m.	20s.		45°	12′	70957	Declination ... 16 36 ...Secant	0.01849
10	44	45		42	16	67258		
							Log. ratio	0.07737
0	55	25				Diff. 3699	Log...	3.56808
0	27	42	Half-elapsed time				Log..........................	0.91875
0	42	15	Middle time				Log....	4.56420
0	14	33	Time from noon				Log. rising	2.30488
							Log. ratio..........................	0.07737
			Natural number ...			169	Log..........................	2.22751
			Natural sine of greater altitude ...			70957		

Nat. co-sine of mer. zen. distance, 71126=44° 40′ S.
Declination 16 36 N.

Latitude... 28 4 S.

By repeating the operation, the latitude comes out the same as above

A direct Method of finding the Latitude by two Altitudes of the Sun, the Time elapsed between the Observations, and the Sun's Declination when the greater Altitude was observed.[*]

RULE 1. Add together the *true altitudes* (found as before), and take half their sum; subtract the less altitude from the greater, and take half their difference.

2. Find the interval between the times of observing the two altitudes, which call *elapsed time;* take half of the elapsed time, and reduce it to degrees, &c. by Table XIX.

3. Add together the *co-secant* of half the elapsed time (reduced as above)[†] and the *secant* of the declination; their sum will be the *co-secant* of *arc first.*

4. Add together the *co-secant* of arc first, the *co-sine* of half the sum of the altitudes, and the *sine* of half their difference: the sum of these logarithms will be the *sine* of *arc second.*

5. Add together the *secant* of arc first, the *sine* of half the sum of the altitudes, the *co-sine* of half their difference, and the *secant* of arc second; their sum will be the *co-sine* of *arc third.*

6. Add together the *secant* of arc first (already found), and the *sine* of the declination; their sum will be the *co-sine* of *arc fourth*, when the latitude and declination are of the same name; but when they are of contrary names, take the supplement for *arc fourth.*

7. Take the sum or difference of arcs third and fourth, for *arc fifth* (See Note.)

8. Add together the *secants* of arc second (already found) and arc fifth; their sum will be the *co-secant* of the *Latitude.*

NOTE. When the sum of arcs third and fourth is equal to, or greater than 90°, their difference is always *arc fifth;* but when their sum is less than 90° (which will rarely happen), it may be doubtful whether their sum or difference ought to be taken for *arc fifth.* But the computation is soon made on both suppositions, for the secant of arc fifth is the last logarithm which is taken from the Table, and the other parts of the calculation are therefore not affected by the change: one of the results must certainly be the required latitude, and the latitude by account will generally be sufficient to determine which of them ought to be taken.

Remarks.

In this method the observations should, if possible, be taken under the same limitations as directed in the former (page 192); these, however, may, in case of necessity, be considerably extended, if the altitudes be taken with care, the elapsed time measured by a chronometer, and the logarithms and arcs taken out to the nearest second.

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[*] This method of finding the Latitude by two Altitudes of the Sun, which is much simpler and more general than the former, and independent of the Latitude by Account, was proposed by Mr. James Ivory, who has given an ingenious solution of it in the Philosophical Magazine for August 1821. Mr. Riddle, of the Royal Naval Asylum, Greenwich, has since considerably improved Mr. I.'s Solution, and given a Rule, similar to the above, in the same work for September 1822.

[†] The Log of the half-elapsed time may be taken from Table XXVII., which will save the trouble of reducing the time to degrees, &c.

In both the methods no allowance is made for the change of the sun's declination during the interval between the observations. This, indeed, might be done; but the operation would be more complicated, while the omission will produce no error of consequence to the navigator, especially if the interval be not considerable.

It will much facilitate the operation if a formula be written out before the commencement of the calculation· and it should be observed, that many of the logarithms may be obtained at the same opening of the Table; thus, the secant and sine of the declination; the secant and co-secant of arc first, the former of which is wanted twice; the sines and co-sines of half the sum and difference of the altitudes; and the sine and secant of arc second; these being taken out together, will considerably expedite the calculation.

EXAMPLE I. (Page 192.)

True Altitudes. Times. ° ′
67° 16′ ....11h. 28m. 0s. A.M. Latitude by account... 41 44 N.
68 24 .... 0 24 40 P.M. Declination .... 20 24 N.

Sum ......135 40 half 67° 50′ 0 56 40 Elapsed time.
Diff. ...... 1 8 half 0 34 0 28 20 Half-elapsed time = 7° 5′
Half-elapsed time. 7° 5′ ...Co-secant 0.90899
Sun's declination. 20 24. ...Secant ... 0.02813 ....Sine. . 9.54229

Arc first............ 6 38. ...Co-secant 0.93712 ..Secant ...... 0.00292 .....Secant 0.00292
Half sum alts...... 67 50. ...Co-sine... 9.57669 ..Sine 9.96665
Half diff. alts...... 0 34. ...Sine ...... 7.99520...Co-sine...... 9.99998

Arc second......... 1 51. ...Sine ...... 8.50901 ..Secant 0.00023*

Arc third .... 21 8. ....Co-sine...... 9.96978

Arc fourth......... 69 27. ....Co-sine 9.54521

Arc fifth .... 48 19. ...Secant ... 0.17717
Secant ... 0.00023*

Latitude ... .. 41° 39′. ...Co-secant 0.17740

EXAMPLE II. (Page 193.)

True Altitudes. Times. ° ′
53° 28′ ....11h. 36m. 29s. A.M. Latitude by account... 50 39 N.
52 9 .... 1 13 53 P.M. Declination .... 15 52 N.

Sum ......105 37 half 52° 48½′ 1 37 24 Elapsed time.
Diff. ...... 1 19 half 0 39½ 0 48 42 Half-elapsed time = 12° 10½′
Half-elapsed time. 12° 10½′. .Co-secant 0.67593
Sun's declination. 15 52. ...Secant ... 0.01687......................................Sine... 9.43680

Arc first............ 11 42. ...Co-secant 0.69230 ..Secant .... 0.00912 ......Secant 0.00912
Half sum alts...... 52 48½...Co-sine... 9.78138...Sine 9.90125
Half diff. alts...... 0 39½...Sine ...... 8.06028...Co-sine...... 9.99997

Arc second......... 1 58. ...Sine ...... 8.53446...Secant 0.00026*

Arc third .... 35 31. ....Co-sine...... 9.91060

Arc fourth......... 73 47. ....Co-sine 9.44592

Arc fifth .... 38 16. ...Secant ... 0.10506
Secant ... 0.00026*

Latitude............ 51° 41′. ...Co-secant 0.10532

EXAMPLE III. (Page 194.)

	True Altitudes. ° ′	° ′	Times. h. m. s.		° ′
	28 33		9 30 0 A.M.	Latitude by account.	32 32 N.
	38 47		11 17 42 A.M.	Declination	17 10 S.
Sum	67 20	half 33 40	1 47 42	Elapsed time.	
Diff.	10 14	half 5 7	0 53 51	Half-elapsed time = 13° 27′ 45″	

	° ′						
Half-elapsed time.	13 28.	Co-secant	0.63287				
Sun's declination.	17 10.	Secant	0.01979			Sine	9.47005
Arc first	12 51½	Co-secant	0.65266	Secant	0.01103	Secant	0.01103
Half sum alts	33 40.	Co-sine	9.92027	Sine	9.74379		
Half diff. alts	5 7.	Sine	8.95029	Co-sine	9.99827		
Arc second	19 29.	Sine	9.52322	Secant	0.02561*		
Arc third	53 4½			Co-sine	9.77870		
Arc fourth	107 37 = (180° − 72° 23′)					Co-sine	9.48108
Arc fifth	54 32½	Secant	0.23649				
		Secant	0.02561*				
Latitude	33 9 N.	Co-secant	0.26210				

EXAMPLE IV. (Page 195.)

	True Altitudes. ° ′	° ′	Times. h. m. s.		° ′
	19 21		10 4 20 A.M.	Latitude by account	60 10 S.
	21 18		1 32 36 P.M.	Declin. at Greenw. time	5 51 N.
Sum	40 39	half 20 19½	3 28 16	Elapsed time.	
Diff.	1 57	half 0 58½	1 44 8	Half-elapsed time = 26° 2′	

	° ′						
Half-elapsed time.	26 2.	Co-secant	0.35764				
Sun's declination.	5 51.	Secant	0.00227			Sine	9.00828
Arc first	25 53.	Co-secant	0.35991	Secant	0.04591	Secant	0.04591
Half sum alts	20 19½	Co-sine	9.97208	Sine	9.54076		
Half diff. alts	0 58½	Sine	8.23086	Co-sine	9.99994		
Arc second	2 6.	Sine	8.56285	Secant	0.00029*		
Arc third	67 16½			Co-sine	9.58690		
Arc fourth	96 30 = (180° − 83° 30′)					Co-sine	9.05419
Arc fifth	29 13½	Secant	0.05913				
		Secant	0.00029*				
Latitude	60 42 S.	Co-secant	0.05942				

EXAMPLE V.

September 8, 1866, in latitude by account 6° 30′ N., at 16h. 28m. 20s., by a chronometer shewing Greenwich mean time, the altitude of the sun's lower limb was 35°10′30″, and at 18h. 48m 20s. by the same chronometer, the altitude was 69° 49′ 30″, the instrument being adjusted, and the height of the observer's eye 18 feet: required the latitude at the time the greater altitude was taken.

	° ′ ″
Sun's declination for mean noon September 8, by Page II. of Nautical Almanac	5 41 32 N.
Corr. for Greenwich mean time, 18h. 48m., when the greater alt. was taken ...	− 17 54
Sun's declination at Greenwich mean time	5 23 38 N.

	° ′ ″		° ′ ″
First obs. alt. of sun's lower limb...	35 10 30	Second obs. alt. of sun's lower limb,	69 49 30
Corr. Table IX. + 10′.5=	+ 10 30	Corr. Table IX. + 11′.4 = ...	+ 11 24
Sun's true alt. at first obs.	35 21 0	Sun's true alt. at second obs.	70 0 54

	True Altitudes. ° ′		Times by Chron. h. m. s.		
	35 21	....	16 28 20	Latitude by acc.	6° 30′ N.
	70 1	....	18 48 20	Declination	5 24 N.
Sum...	105 22	Half 52° 41′	2 20 0 Elapsed time.		
Diff....	34 40	Half 17 20	1 10 0 Half-elapsed time = 17° 30′		

	° ′						
Half-elapsed time	17 30...	Co-secant	0.52186				
Sun's declination,	5 24...	Secant ...	0.00193	....		Sine...	8.97363
Arc first	17 25...	Co-secant	0.52379...	Secant ...	0.02038	.........Secant	0.02038
Half-sum alts. ...	52 41...	Co-sine...	9.78263...	Sine	9.90053		
Half-diff. alts. ...	17 20...	Sine	9.47412...	Co-sine ...	9.97982		
Arc second	37 6½..	Sine	9.78054...	Secant ...	0.09827*		
Arc third	3 53	....	....	Co-sine ...	9.99900		
Arc fourth.........	84 20..	....	....	....	....	Co-sine	8.99401
Arc fifth	80 27...	Secant ...	0.78013				
		Secant ...	0.09827*				
	° ′						
Latitude	7 36 N....	Co-secant	0.87840				
Arc fifth	88 13	Secant ...	1.50696				
		Secant ...	0.09827*				
Latitude	1 25 N....	Co-secant	1.60523				

Note. A double computation as here shewn, can never occur, except, when the *sun is nearly vertical*, with the latitude and declination of the *same name*.

The sum of the third and fourth arcs being less than 90°, this example admits of two answers: first, by taking the difference of the arcs, the latitude comes out 7° 36′; and by taking their sum, the latitude will be 1° 25′; but it is evident that the former, *agreeing nearly with the latitude by account*, will be the required latitude.

Had this Example been worked to seconds the latitudes would have been 7° 37′ 29″ and 1° 23′ 3″.

Note. By the preceding method, the latitude may be found by two observed altitudes of a star; but in this case it will be necessary to reduce the interval between the observations, as measured in mean solar time by a watch or chronometer, to sidereal time by Table XXXVIII, as explained in the use of that Table.

EXAMPLES FOR EXERCISE.

1. October 19, 1866, in latitude by account 49° 0′ N., at 0h 34m. P.M. the sun's true altitude was 31° 2′, and at 2h. 46m. P.M. it was 22° 34′ required the true latitude.
Answer. 48° 50′ North.

2. February 25, 1866, in latitude 49° 36′ N. by account, at 0h. 33m. P.M. the observed altitude of the sun's lower limb was 30° 49′, and at 2h 43m. P.M. it was 21° 30′, the height of the observer's eye being 14 feet: required the true latitude.
Answer. 49° 34′ North.

3. July 7, 1866, in latitude 58° 25′ N. by account, and longitude 30° 30′ W., at 11h. 2m. A.M. per watch, the altitude of the sun's lower limb was 52° 18′, and at 1h. 25m. P.M. the altitude was 50° 50′, the sun at that time bearing S. W. by W. by compass; the height of the observer's eye being 20 feet, and the ship's course during the elapsed time S. S. W. ½ W., sailing at the rate of 8 knots per hour: required the ship's true latitude at the time when the greater altitude was observed.
Answer. 58° 43′ North.

4. August 30, 1866, in latitude 12° 43′ S. by account, and longitude 44° 15′ East, at 1h. 13m. 30s. P.M., the altitude of the sun's lower limb was 61° 35′ 15″, and at 3h. 15m. 12s. P.M. it was 36° 45′ 30″ bearing at that time N. W. ½ W.: during the elapsed time the ship was sailing S. W. by W. at the rate of 4 knots per hour, and the height of the observer's eye was 20 feet: required the true latitude at the time of taking the greater altitude.
Answer. 12° 25′ South.

To find the Latitude by an Altitude of the Sun taken near the Meridian; having the Apparent Time from Noon, the Latitude by Account, and the Sun's Declination at the Time of Observation.

Rule 1. From the observed altitude, find the sun's true altitude, and reduce the declination, taken from Page I. of the month in the Nautical Almanac, to the apparent time of observation by Table XXI. or XXXIII.

2. Add together the log rising of the time from noon (XXIX.)
the log. co-sine of the latitude (XXV.)
and the log. co-sine of the declination;
the natural number corresponding to the sum of these three logarithms (rejecting the tens in the index) (XXIV.) being found, and added to the

natural sine (XXVI.) of the true altitude, will give the natural co-sine of the meridian zenith distance, to which apply the declination, as before, and the result will be the latitude.

Should the latitude thus found, differ materially from the latitude by account, it will be advisable to repeat the operation, using that latitude instead of the latitude by account.

Note. The apparent time at the ship when the altitude is taken, may be ascertained by altitudes observed when the sun is at a proper distance from the meridian, as shewn hereafter, and the error it then had, applied to the time shewn by the same watch when the altitude is taken; and should the ship have changed her meridian since the error of the watch was ascertained, the difference of longitude made, must be reduced into time by Table XIX., and added thereto, if east, or subtracted from it, if west.

Or, the apparent time at the ship may be obtained by means of a chronometer shewing mean time at Greenwich, by applying to that time the equation taken from Page II of the month in the Nautical Almanac, in order to reduce it to apparent time at Greenwich: to this add the longitude of the ship (reduced into time by Table XIX.), if it be east, or subtract it, if west, and the result will be the apparent time at the ship.

The observations should be taken within the following limits, *viz.*, the number of the minutes in the time from noon should not exceed the number of degrees of the sun's meridian zenith distance. (See Note at the bottom of Page 192.)

EXAMPLE I.

October 11, 1866, in latitude by account 46° 8′ N., and longitude 135° 30′ E., suppose the altitude of the sun's lower limb to be 36° 33′ 00″ at 0h 28m. 10s. P. M., ship time by a watch previously regulated; the height of the observer's eye being 18 feet: required the ship's true latitude.

	h m.
App. time at ship, October 11	0 28
	24
App. time at ship, October 10	24 28
Long. 135° 30′ in time (XIX.)	9 2 E.
App. time at Greenwich, October 10. ...	15 26

	° ′ ″
Obs. alt. of sun's lower limb	36 33 00
Dip of the horizon	− 4 4
	36 28 56
Refraction − parallax	− 1 10
	36 27 46
Sun's semidiameter by N. A. ...	+ 16 4
Sun's true altitude	36 43 50

	° ′ ″
Sun's declination, October 10, (by p. I N. A.)	6 39 40 S.
Hourly diff. + 56″.91 × 15½h. = 882″.10 = ...	+ 14 42*
Sun's declination at Greenwich time	6 54 22 S.

	h. m. s.		
Time from noon	0 28 10	............Rising	2.87753
Latitude by account ...	46° 8′ N.	............Co-sine	9.84072
Sun's declination	6 54 S.	............Co-sine	9.99684
		Nat. number ... 519......Log....	2.71509
Sun's true altitude......	36° 44′	Nat. sine 59809	
Merid. zenith distance..	52 54 N.	Nat. co-sine ... 60328	
Sun's corr. declination..	6 54 S.		
Latitude	46 0 N.		

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* Or thus, if corrected by Table XXI., the corr. for 15½h. will be 14′ 45″.

EXAMPLE II.

July 3, 1866, in latitude by account 26° 13′ S., and longitude 166° 15′ W. at 11h. 48m. 40s. A.M., by a watch, whose error had been previously found to be 7m 30s. *fast* for apparent time at ship, suppose the altitude of the sun's *upper limb* was 41° 2′ 10″ N., the height of the observer's eye being 20 feet, and the ship having made 38 miles of longitude to the eastward since the watch was regulated: required the true latitude of the place of observation.

	h.	m.	s.	
Time by the watch 11 48 40 A.M. 3 d. =	23	48	40	July 2nd.
The watch *fast* of ship time	−	7	30	
Time corrected for error of watch...	23	41	10	
Long. made (38′) since error was found	+	2	32	E.
Apparent time at the ship	23	43	42	July 2.
	24			
Apparent time before noon......... .	0	16	18	July 3.

	h.	m.	
Apparent time at ship	23	44	July 2.
Long. 166° 15′ in time (XIX)	11	5	W
	34	49	
	24		
App. time at Greenwich ...	10	49	July 3.

	°	′	″	
Obs. alt. of sun's *upper limb*	41	2	10	N.
Dip of the horizon... − 4′ 17″ Refrac. − parallax ... − 59	−	5	16	
	40	56	54	
Sun's semidiam. by N. A.	−	15	46	
Sun's true altitude	40	41	8	

	°	′	″	
Sun's declin. p. I, N. A.	22	58	35	N. July 3.
Hr. diff. − 12.07″ × 10¾ h. =	−	2	10*	
Sun's dec. at Green. time	22	56	25	N.

* By Table XXI. the corr. for declin. is 2′ 13″

Time from noon	0 h. 16 m. 18 s.			Rising	2.40265
Latitude by account ...	26° 13′ S.			Co-sine	9.95286
Sun's declination.........	22 56½ N.			Co-sine	9.96422
		Nat. number ..	209	Log ...	2.31973
Sun's true altitude	40° 41′	Nat. sine.....	65188		
Merid. zenith distance ...	49 9½ S.	Nat. co-sine ...	65397		
Sun's declination	22 56½ N.				
Latitude	26 13 S.				

EXAMPLE III.

September 22, 1866, in latitude by account 50° 10′ N., and longitude 20° 36′ W., the altitude of the sun's lower limb being 40° 12′ 15″ S., when a chronometer shewed 2h. 1m. 43s. mean time at Greenwich; the error of the instrument 1′ 20″ to add, and the height of the observer's eye 20 feet: required the true latitude.

	h.	m.	s.	
Mean time at Greenwich by chronometer	2	1	43	
Equation of time, Sept. 22, by page II. of N. A.	+	7	18	
App. time at Greenwich by chronometer	2	9	1	
Longitude of ship in time (Table XIX,)	1	22	24	W.
Apparent time at ship	0	46	37	

	°	′	″			°	′	″
Sun's dec Sept. 22, by page I. N.A.,	0	18	28	N.	Obs. alt. sun's lower limb	40	12	15
Corr. for app. time at Green. (XXI.)	−	2	7		Index error	+	1	20
Sun's declin. at Greenwich time	0	16	21	N.		40	13	35
					Corr. (Table IX.) + 10′.4 =	+	10	24
					Sun's true altitude	40	23	59

	h. m. s.		
Time from noon	0 46 37	Rising	3.31419
Latitude by account	50° 10′ N.	Co-sine	9.80656
Sun's declination	0 16 N.	Co-sine	9.99999
		Nat. number 1321 ...... Log	3.12074
Sun's true altitude	40 24	Nat. sine ... 64812	
Sun's true zenith dist.	48 36 N.	Nat. co-sine. 66133	
Sun's declination	0 16 N.		
Latitude	48 52 N.		

By repeating the operation, with the latitude as above, the true latitude comes out 48° 52′ N.

EXAMPLES FOR EXERCISE.

1. May 10, 1866, (*civil time*), in latitude by account 38° 26′ S., and longitude 22° 40′ E., the altitude of the sun's upper limb was 33° 21′ 30″ N., when a watch, previously regulated, shewed 11h. 10m. 15s. A. M., the height of the observer's eye being 24 feet, and the error of the instrument + 2′ 15″: required the true latitude.

Answer. 38° 9½′ South.

2. November 10, 1866, in latitude by account 60° 12′ N., and longitude 32° 30′ W., at 0h. 56m.. 12s. P. M., by a watch whose error had been previously found to be 4m. 18s. too *slow* for apparent time at ship, the altitude of the sun's lower limb was 11° 48′ 45″ South of the zenith, the height of the observer's eye being 18 feet, and the ship having made 24 miles of longitude to the westward since the error of the watch was found: required the true latitude.

Answer. 59° 56½′ North.

3. March 15, 1866 (*civil time*), in latitude by account 47° 42′ S., and longitude 168° 20′ E., the altitude of the sun's lower limb was 44° 6′ 15″ N., when a chronometer shewed 12h. 25m. 55s. mean time at Greenwich, March 14, the error of the instrument being — 2′ 0″, and the height of the observer's eye 12 feet: required the true latitude.

Answer. 47° 34′ South.

ON THE VARIATION OF THE COMPASS.

The Variation of the Compass is the deviation of the points of the Mariner's Compass from the corresponding points of the horizon, and is termed *east* or *west* variation, according as the magnetic needle, or north point of the compass, is inclined to the eastward or westward of the true north point of the horizon.

For many years after the discovery of the compass, it was supposed that the needle exactly coincided with the plane of the meridian, and consequently that all the points of the compass agreed with the correspondent points of the horizon. In the year 1492, Columbus first observed that the needle deviated from the north and south points of the horizon; but still imagined this deviation was constantly the same: however, in 1634, Mr. Edward Gillibrand, Professor of Astronomy in Gresham College, discovered, from a comparison of his own observations with those of his predecessors, that the variation was not always the same at the same place; for in that year he found that the variation of the compass at Deptford was 4° 4′ East, which, compared with the same as observed by Mr. Burrows, in 1580, at Limehouse, who had found it to be 11° 15′ E., plainly shewed, that in the course of 54 years the variation had diminished more than 7 degrees. In 1657, according to Mr. Bond's observations, there was no variation of the compass at London: since that time the needle has been declining westward, and is at present about 23° 10′ West.*

It likewise appears, from observations made in various parts of the world, that in different places the variation differs both as to its quantity and denomination, being west in some places and east in others: thus, off the South Coast of Ireland the variation is at present about 30° West; but near Cape Horn, in South America, it is 22° East.

But besides the deviation of the needle from the plane of the true meridian, which it acquires after being touched with a magnet, it obtains another property called the *dip;* that is, although the needle be properly balanced beforehand, it will now lose its horizontal position, and one end will incline below the horizon, while the other will be elevated, so that it will be necessary to attach a weight to the elevated end, in order to restore it to a horizontal position when supported on the central pin. The angle that it makes with the horizon is called the *dip of the needle.* Near the equator it inclines but little from the horizontal plane; but one end is depressed the more as we advance towards the poles—the north end in the northern hemisphere, and the south end in the southern hemisphere.

The needle is also subject to a *local attraction*, resulting principally from the masses of iron on board ship, by which it will be drawn more or less from the magnetic meridian, according as the disturbing cause is situated with regard to the needle; this effect is called the *aberration of the needle.* Now, as a ship in traversing is constantly changing its direction, the iron contained therein must be carried by it into different positions with respect to the compass, and by its attraction will continually change the direction, of the needle. If westerly variation be increased, or easterly variation diminished, when the ship's head is in a westerly direction, the contrary effect will be produced when the ship's head is brought round to an easterly direction, that is, westerly variation will be diminished, and easterly increased: hence it will be necessary to determine the actual variation of the compass, when the ship's head is directed to different points of the horizon. In the northern hemisphere, when the compass is placed at or near the binnacle, the north point of the needle is attracted or drawn forward towards the ship's head; and the south point, in the southern hemisphere.

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* According to the accurate observations of the late Colonel Beaufoy, made near London. the variation of the needle had arrived at its maximum in March 1819, when it was at noon 24 41′ 42″ West; the needle has since that time been retrograding, the magnetic north gradually inclining to the eastward, and consequently the westerly variation decreasing.

The greatest aberration takes place when the ship's head is at or near the east or west points, and decreases towards the magnetic meridian, in the proportion of radius to the sine of the angle between the ship's head and the magnetic meridian.

The most simple method of ascertaining the aberration, and from thence the actual variation of the compass, when the ship's head is in any given direction, is to observe the variation when the ship's head is brought alternately to the east and west points; half the sum of these variations will be the true variation, and half the difference will be the greatest aberration of the needle, arising from local attraction: then, to find the aberration, and from thence the actual variation, when the ship's head is on any other point of the compass, enter a Traverse Table with the given number of points from North or South, at the top or bottom, and the greatest aberration, reduced to minutes, in a distance column; opposite to which, in the corresponding departure column, will be found the aberration in minutes, when the ship's head is on the given point of the compass; then, if the ship be in the northern hemisphere, allow the aberration to the right-hand of the true variation, when the given point is to the eastward of the magnetic meridian, or to the left-hand when the given point is to the westward; but the contrary to this rule is to be observed when the ship is in the southern hemisphere: the result will give the actual variation when the ship's head is on the given point of the compass.

Example. Suppose, when the ship's head bore east, being in north latitude, the observed variation was 21° 30′ W., but when the ship's head was put about to west, the observed variation was 27° 30′ W.: required the true variation independent of local attraction, the greatest aberration of the needle, and the actual variation when the ship's head is on each second point of the compass.

	°	′		°	′
Variation with ship's head East ...	21	30 W.	....	21	30 W.
Variation with ship's head West...	27	30 W	....	27	30 W.
2)	49	0	2)	6	0
True variation...........	24	30	Greatest aberration	3	0=180′

Now, to find the aberration of the needle when the ship's head is two points from the north or south, enter Table 1, with two points at the top, and the greatest aberration 180′ in a distance column, opposite to which, in the corresponding departure column, will be 69′=1° 9′, the aberration required: this aberration being allowed to the right-hand when the ship's head is to the eastward, diminishes the true variation 24° 30′ W., and therefore subtracted from it leaves 23° 21′, the variation to be allowed when the ship's head is N. N. E. or S. S. E.; but as the aberration is to be allowed to the left-hand when the ship's head is to the westward, consequently increasing the variation, add the above together, and their sum 25° 39′ will be the variation when the ship's head is N. N. W. or S. S. W.

In the same manner the variations may be found, corresponding to the other points of the compass.

The variations may then be formed into a table as follows:

Ship's Head by Compass.	Variations.		Ship's Head by Compass.	Variations.	
	°	′		°	′
North	24	30 W.	South	24	30 W.
N. N. E.	23	21	S. S. W.	25	39
N. E.	22	23	S. W.	26	37
E. N. E.	21	44	W. S. W.	27	16
East.	21	30	West	27	30
E. S. E.	21	44	W. N. W.	27	16
S. E.	22	23	N. W.	26	37
S. S. E.	23	21	N. N. W.	25	39

Hence the variations to be allowed are opposite the courses steered: thus, if the ship's head is E. N. E., the variation to be allowed is 21° 44′ W.; but if W. S. W., the variation to be allowed is 27° 16′ W.

The observations for determining the variation should be made with an azimuth compass placed amidship on, or as near to, the binnacle as can be safely done; and the steering compass should be compared with the azimuth compass, to ascertain that there is no difference in the direction of the needles, since the local attraction of the iron in the ship will affect the needle differently in different parts of it.[*]

The VARIATION OF THE COMPASS is found by comparing together the sun's true and magnetic amplitudes or azimuths.

The TRUE AMPLITUDE of any celestial object is an arch of the horizon contained between the true east or west points thereof, and the centre of the object at the time of its rising or setting; or, it is the degrees and minutes the object rises or sets to the northward or southward of the true east or west points of the horizon.

The MAGNETIC AMPLITUDE is an arch contained between the east or west points of the compass and the centre of the object at rising or setting; or, it is the bearing of the object, by compass, when in the horizon.

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[*] Mr. Barlow, of the Royal Military Academy at Woolwich, has invented an apparatus for neutralizing the effect of local attraction on the needle of the ship's compass; this consists of a small iron plate, fixed in such a situation behind, and near to, the steering compass, that its local action may exactly counterpoise the magnetic power of all the iron in the ship.

The TRUE AZIMUTH of an object is an arch of the horizon contained between the true meridian and the azimuth, or vertical circle passing through the centre of the object.

The MAGNETIC AZIMUTH is an arch contained between the magnetic meridian and the azimuth, or vertical circle passing through the centre of the object; or it is the bearing of the object, by compass, at any time when it is above the horizon.

The true amplitude, or azimuth, is found by calculation; and the magnetic amplitude, or azimuth, by an azimuth compass.

The following is a description of Mr. M'Culloch's patent Azimuth Compass, with the method of observing amplitudes, or azimuths, by the same.

DESCRIPTION OF THE AZIMUTH COMPASS.

Figure 2, Plate VIII., is a representation of the azimuth compass ready for observation. The needle in this compass is bent in such a manner, that the point of the conical pivot on which it moves, and is supported, may be brought very near to the centre of gravity, as well as to the centre of motion. The card is similar to those of the steering compass, with this difference only, that a circular ring of silvered brass, divided into 360°, or rather into four times 90°, circumscribes the card. *b* represents the compass box, which is brass, and has a hollow conical bottom. *e* is the prop upon which the compass is supported, instead of gimbols. It stands in a brass socket, screwed to the bottom of the wooden box, and may be turned round at pleasure. *h* is one of the guards; the other, being directly opposite, is hid by the box. Each guard has a slit, in which a pin, projecting from the side of the box, may move freely in a vertical direction. 1 is a brass bar, upon which, at right angles, the sight-vanes are fixed: a line is drawn along the middle of this bar; which line, the lines in the vanes, and the thread joining their tops, are all in the same plane. 2 is a coloured-glass, which may be moved up or down the sight-vane 3. 4 is a magnifying-glass, moveable on the other vane, whose focal distance is nearly equal to the distance between the vanes. 5 is the nonius, or vernier, which contains six divisions; and as the limb of the card is divided into half degrees, each division of the nonius is therefore five minutes. The interior surface of the nonius is ground concave to the segment of a circle of the same diameter as the circle of the card. 6 is a stopper, or screw, connected with the nonius, which serves to move the nonius close to the card, and thereby prevent it from vibrating as soon as the observation of the amplitude, or azimuth, is completed. 7 is a convex lens, to assist the eye in reading off the observed amplitude, or azimuth. 8 is a milled head, by which the card may be lifted off the centre, and prevented from vibrating when the compass is not wanted for use.

USE OF THE AZIMUTH COMPASS.

To observe the Sun's Amplitude.

Turn the compass-box, until the vane containing the magnifying-glass is directed towards the sun; and when the bright speck, or rays of the sun collected by the magnifying-glass, falls upon the slit in the other vane, stop the card by means of the nonius, and read off the amplitude.

Without using the magnifying-glass, the sight may be directed through the dark glass towards the sun; and in this case, the card is to be stopped when the sun is bisected by the thread in the other vane.

The observation should be made when the sun's lower limb appears somewhat more than his semidiameter above the horizon, because his centre is really then in the horizon, although it is apparently elevated, on account of the refraction of the atmosphere: this is particularly to be noticed in high latitudes.

To observe the Sun's Azimuth.

Raise the magnifying-glass to the upper part of the vane, and move the box, as before directed, until the bright speck falls on the other vane, or on the line in the horizontal bar; the card is then to be stopped, and the divisions being read off, will be the sun's magnetic azimuth.

If the card vibrate considerably at the time of observation, it will be better to observe the extreme vibrations, and take their mean as the magnetic azimuth. When the magnetic azimuth is observed, the altitude of the object must be taken, in order to obtain the true azimuth.

It will conduce much to accuracy, if several azimuths be observed, with the corresponding altitudes, and the mean of the whole taken for the observation.

To find the Variation of the Compass by an Amplitude.

Rule 1. With the given time and longitude, find the corresponding time at Greenwich, by the Rules in page 155, and to that time reduce the sun's declination, (XXI.) taken from Table X., or the Nautical Almanac.

2. To the log. secant of the latitude of the ship, rejecting the index (XXV.), add the log. sine of the sun's reduced declination; their sum will be the log. sine of the true amplitude*, to be reckoned from the east in the morning, or from the west in the afternoon, towards the north or south, according to the declination.

3. Then, if the true and magnetic amplitudes be both north, or both south, their difference is the variation; but if one be north, and the other south, their sum is the variation: and to know whether it be easterly or westerly, suppose the observer looking towards that point of the compass representing the magnetic amplitude; then, if the true amplitude be to the right-hand of the magnetic, the variation is east, but if to the left-hand it is west.

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* The true amplitude may likewise be found approximately by Table XLII.

EXAMPLE I.

Required the sun's true amplitude on November 6, 1866, in latitude 48° 21′.

Latitude	48° 21′	Secant	0.17745
Declination	16 1 S.	Sine	9.44078
True amplitude	24 32	Sine	9.61823

Hence the sun will rise E. 24° 32′ S., or E. S. E. ¼ S. nearly; and set W. 24° 32′ S., or W. S. W. ¼ S. nearly.

EXAMPLE II.

July 3, 1866, in latitude 9° 36′ S., the sun was observed to rise East 12° 42′ N.: required the variation of the compass.

Latitude	9° 36′S.	Secant	0.00613
Declination	22 59 N.	Sine	9.59158
True amplitude, E.	23 20 N.	Sine	9.59771
Mag. amplitude, E.	12 42 N.		
Variation	10 38 West, the amplitude being to the *left* of the magnetic.		

EXAMPLE III.

September 24, 1866, in latitude 26° 32′ N., and longitude 138° W., the sun's centre was observed to set W. S. W., about 6h. P. M.: required the variation of the compass.

	h. m.		° ′ ″
App. time at ship, Sept. 24	6 0	Sun's declination, by p. I. N. A.	0 28 18 S.
Long. 138° in time (Table XIX.)	9 12 W.	Corr. for 15h. 12m. (Table XXI.)	+ 14 55
App time at Greenwich	15 12	Sun's declin. at Greenwich time	0 43 13 S.

Latitude	26°32′N.	Secant	0.04834
Sun's declination	0 43 S.	Sine	8.09718
True amplitude, W.	0 48 S.	Sine	8.14552
Mag. amp. W. S. W = W.	22 30 S.		
Variation	21 42 East, the true amplitude being to the *right* of the magnetic.		

EXAMPLE IV.

Being at sea, in latitude 43° 36′ N., and longitude 98° West, on Feb. 15, 1866, I observed the sun's centre, at setting, W. 6° 45′ N. at 6h. 52m. P.M. apparent time: required the variation of the compass.

	h. m.		° ′ ″
App. time at ship, Feb. 15	6 52	Sun's declination, by page I. N. A.	12 38 26 S.
Long. 98° in time (Table XIX.)	4 32 W.	Corr. for 13h. 24m. (Table XXI.)	− 11 17
App. time at Greenwich	13 24	Sun's declin. at Greenwich time	12 27 9 S.

Latitude	43°	36′ N.	......Secant ...	0.14016
Sun's declination...	12	27 S.	......Sine	9.33362
True amplitude W.	17	19 S.	......Sine	9.47378
Mag. amplitude, W.	6	45 N.		
Variation	24	4 West, the true amplitude being to the *left* c the Magnetic.		

EXAMPLES FOR EXERCISE.

1. July 12, 1866, in latitude 42° 12′ S., and longitude 14° 15′ W., at 4h. 35m. P. M., apparent time, the sun set N. W. ½ W., by compass: required the variation.

Answer. 9° 5′ West.

2. December 10, 1866, (*civil time,*) in latitude 54° 35′ N., and longitude 53° 15′ W., the sun's centre was observed to rise S. by E., at 8h. 27m. A. M., apparent time: required the variation of the compass.

Answer. 36° 30′ West.

3. March 9, 1866, (*civil time,*) in latitude 10° 2′ S., and longitude 168° E., the sun's magnetic amplitude at rising was observed to be E. 6° 36′ N., at 5h. 57m. A. M., apparent time: required the variation of the compass.

Answer. 11° 25′, or 1 point nearly, East.

4 November 13, 1866, in latitude 32° 36′ N., and longitude 74° 15′ W. at 5h. 15m. P. M., apparent time, the sun was observed to set, by an azimuth compass, W. 21° 38′ S.: required the variation.

Answer. No variation.

5. March 20th, 1866, in latitude 51° 15′ N., and longitude 23° 15′ W., at 6h. 15m. P. M., apparent time, the sun's centre was observed to set N. W. by W. ½ W.; required the variation of the compass.

Answer. In this Example, the sun (*having no declination*) sets due West, and the magnetic amplitude being N. W. by W. ½ W., or 2½ points to the northward of West, the variation is 2½ points West, the true amplitude being to the *left* of the magnetic.

To find the Variation of the Compass by an Azimuth.

Rule 1. With the given time and longitude, find the correspondin time at Greenwich by the Rules in page 155, and to that time reduce tl sun's declination (XXI.) taken from Table X., or the Nautical Almanac: compute also the sun's true altitude.

2. Subtract the sun's declination from 90°, when the latitude and declination are of the same name, or add it to 90°, when they are of contrary names; and the sum, or remainder, will be the sun's polar distance.

3. Add together the sun's true altitude, the latitude of the ship, and the sun's polar distance; take the difference between half their sum and the polar distance, and note the remainder:

4. Then add together,
the log. secant of the altitude (XXV.) } rejecting their indices
the log. secant of the latitude ………… }
the log. co-sine of the half sum,
and the log. co-sine of the remainder.

5. Half the sum of these four logarithms will be the sine of an arch, which doubled, will be the sun's true azimuth; to be reckoned from the south in north latitude, and from the north in south latitude; towards the east in the morning, and towards the west in the afternoon.

6. Then, if the true and observed azimuths be both reckoned from the north, or both from the south, their difference is the variation; but if one be reckoned from the north, and the other from the south, subtract the true azimuth from 180°, and the difference between the remainder and the magnetic azimuth will be the variation: and to know if it be east or west, suppose the observer looking towards that point of the compass representing the magnetic azimuth; then, if the true azimuth be to the right of the magnetic, the variation is east, but if the true be to the left of the magnetic the variation is west.

EXAMPLE I.

July 20, 1866, in latitude 21° 42′ N., and longitude 179° E., at 6h. 20m. A.M. (or July 19, at 18h. 20m., *astronomical time*), the sun's azimuth, by the compass, was observed to be S. 100° 16′ E., at the same time that the altitude of his lower limb was 23° 36′; the height of the observer's eye being 24 feet: required the variation of the compass.

	h. m.		° ′ ″
App. time at ship, July 19 ………	18 20	Sun's dec. July 19 (p I. N. A.)	20 51 44 N.
Long. 179° in time (Table XIX.)	11 56 E.	Corr. for 6h. 24m. (Table XXI.)	– 2 54
App. time at Greenwich, July 19,	6 24	Sun's declin. at Greenwich time	20 48 50 N. 90
	° ′ ″		
Obs. alt. of sun's lower limb ……	23 36 0	Sun's polar distance …………	69 11 10
Corr. from Table IX. + 8′.8 = …	+ 8 48		

True altitude of sun's centre	23 44 48	…Secant……	0.03843
Latitude ………………………	21 42	…Secant……	0.03192
Polar distance ………………	69 11′		
Sum …………………………	114 38		
Half-sum ……………………	57 19	……Co-sine …	9.73239
Remainder……………………	11 52	……Co-sine …	9.99062
			2)19.79336
	° ′		
	52 1 2	……Sine ……	9.89668
True azimuth ………S.	104 2 E.		
Magnetic azimuth……S.	100 16 E.		
Variation	3 46	West, the true azimuth being to the *left* of the magnetic.	

EXAMPLE II.

November 2, 1866 in latitude 25° 31′ N., and longitude 50° 30′ E., the altitude of the sun's lower limb was observed to be 15° 37′ 12″, about 4h. 10m. P.M., his magnetic azimuth at that time being S. 58° 32′ W., and the height of the observer's eye 18 feet: required the variation of the compass.

	h. m.		° ′ ″
App. time at ship, Nov. 2............	4 10	Sun's declin. Nov. 2,(p. I. N. A.)	14 46 33 S.
Long. 50½° in Time (Table XIX.)	3 22 E.	Corr. for 0h. 48m. (Table XXI.)	+ 0 37
App. time at Greenwich, Nov. 2...	0 48	Sun's declin. at Greenwich time	14 47 10 S.
			90
	° ′ ″		
Obs alt. of sun's lower limb	15 37 12	Sun's polar distance	104 47 10
Corr. from Table IX. + 8′.8 =...	+ 8 48		

	° ′		
True altitude of sun's centre.	15 46	......Secant......	0.01666
Latitude	25 31	......Secant......	0.04457
Polar distance	104 47		
Sum	146 4		
Half-sum	73 2	......Co-sine ...	9.46511
Remainder	31 45	......Co-sine ...	9.92960
			2)19.45594
	32 19	......Sine.........	9.72797
	2		
True azimuth............S.	64 38 W.		
Magnetic azimuth......S.	58 32 W.		
Variation	6 6	East, the true azimuth being to the *right* of the magnetic.	

EXAMPLE III.

February 14, 1866, in latitude 36° 18′ S., and longitude 73° 30′ E., about half-past 4 A.M. *(civil time)*, the following altitudes of the sun's lower limb, with the corresponding azimuths, were observed; the height of the observer's eye being 30 feet: required the variation of the compass.

Azimuths. ° ′	Altitudes. ° ′
S. 87 15 E.	11 12
87 0	11 52
86 40	12 44
86 10	13 17
85 45	13 50
5)432 50	62 55
S. 86 34 E.	12 35

	h. m.		° ′ ″
Time at ship, Feb. 13.	16 30	Sun's dec. Feb. 13, (N.A.)	13 19 17 S.
Long. in time (XIX)	4 54 E.	Cor. for 11h. 36m. (XXI.)	− 9 32
Time at Greenwich ...	11 36	Sun's dec. at Greenwich ...	13 9 45 S.
			90
	° ′ ″		
Obs. alt. sun's L. L.	12 35 0	Sun's polar distance.........	76 50 15
Cor. Tab. IX. + 6′.7 =	+ 6 42		
Sun's true altitude...	12 41 42		

	° ′		
Sun's true altitude	12 42	Secant	0.01076
Latitude	36 18	Secant	0.09370
Polar distance	76 50		
Sum	125 50		
Half-sum	62 55	Co-sine	9.65828
Remainder	13 56	Co-sine	9.98703
		2)	19.74977
	° ′		
	48 34	Sine	9.87488
	2		
True azimuth N.	97 8 E.		
	180		
Or S.	82 52 E.		
Magnetic azimuth S.	86 34 E.		
Variation	3 42 East, the true azimuth being to the *right* of the magnetic.		

EXAMPLES FOR EXERCISE.

1. March 8, 1866, in latitude 12° 36 S., and longitude 155° 30′ E., at 6h 36m. P. M., apparent time, the sun's magnetic azimuth was observed to be S. 79° 15′ W., at the same time the altitude of his lower limb was 9° 46′ 0″; the height of the observer's eye being 16 feet, and the error of the instrument + 3′ 30″: required the variation of the compass.
Answer. 7° 53″ East.

2. August 6, 1866 (*civil time*), in latitude 18° 27′ S., and longitude 5° 32′ W., at 7h. 44m. A. M., apparent time, the sun's magnetic azimuth was observed to be N. 81° 40′ E., when the altitude of his lower limb was 17° 49′ 0″; the height of the observer's eye being 22 feet, and the error of the instrument + 3′ 45″: required the variation of the compass.
Answer. 17° 2′ West.

3. May 21, 1866, in latitude 52° 12′ N., and longitude 165° 40′ E., when a chronometer shewed 17h. 56m. 34s., May 20, mean time at the meridian of Greenwich, the sun's azimuth, by compass, was observed to be S. 82° 58′ W.: the altitude of his lower limb being at the same time 23° 48′ 30″, and the height of the observer's eye 12 feet: required the variation of the compass.
Answer. 9° 26′ East.

4. September 1, 1866, (*civil time*), in latitude 31° 20′ S., and longitude 33° 12′ E., when a chronometer shewed 17h. 48m., August 31, mean time at Greenwich, the altitude of the sun's lower limb was 15° 2′ 0″, and his magnetic azimuth N. 70° 2′ E.; the height of the observer's eye being 22 feet, and the index error — 2′ 30″: required the variation of the compass.
Answer. No variation.

ON HADLEY'S SEXTANT

THIS Instrument is constructed on the same principles as the quadrant; but as it is used to measure the *angular* distance between the moon and the sun, a star, or a planet, in order to determine the longitude, the arch is extended to 120 degrees, for the purpose of measuring their distance when greater than 90 degrees: it is also provided with some appendages not commonly annexed to a quadrant, in order to take the observations with greater accuracy; which will be described in the following pages.

Fig. I. Plate IX. represents a Sextant, the frame of which is sometimes made of ebony, but generally of brass, or other hard metal. The arch AA is, on the common instruments, made of ivory, and divided into 120 degrees, each degree into 3 parts, of course equal to 20 minutes, which is again subdivided by the nonius into half-minutes, or 30 seconds, each second-division, or minute, on the nonius, being cut longer than the intermediate ones. The nonius is numbered at every fifth of these longer divisions, from the right towards the left, with 5, 10, 15, and 20; the first division towards the right-hand, marked 0, being called the *index division*.

But the best sextants, which have metal arches, are usually divid quarter minutes; in which case the degrees on the arch are divided into 4 equal parts, or 15 minutes; and the minutes on the nonius into the like number, each equal to 15 seconds.

On some sextants the degrees are divided into six equal parts, each representing 10 minutes; and the minutes on the nonius also into six parts, or 10 seconds each. The nonius is sometimes placed above, and sometimes below the arch.

Figure 8 represents part of the arch of a sextant, the degrees of which are divided into 4 equal parts, and the minutes of the nonius scale into the like number. In this figure the index division, or 0 of the nonius, which is placed above the arch, stands between 25° 15′ and 25° 30′ on the arch; and that division of the nonius exactly coinciding with one on the arch, is the second, or 30″ to the left of 7 minutes, or 7′ 30″, therefore the whole extent between the index division and the 0 on the arch is 25° 22′ 30″.

Again, in figure 9, where the nonius is below the arch, the 0 on the nonius is somewhat more than three divisions, or 30′, to the left of 56°; and the division on the nonius, coinciding with one on the arch, is 5′, therefore the angle pointed out by the index division is 56° 35′.

When the index division is to the right of 0 in the arch, or as it is called on the *arch of excess*, the divisions are to be counted from left to right both on the arch and on the nonius; thus, suppose on an instrument divided as in figure 8, the 0 on the nonius was rather more than three divisions to the right of 0 on the arch, and that the third long division on the nonius (representing minutes) from the left, marked 15, coincided exactly with a division on the arch, then the whole arch would be 48 minutes, that is 45 minutes on the arch of excess, and 3 minutes on the nonius.

HADLEY'S SEXTANT.

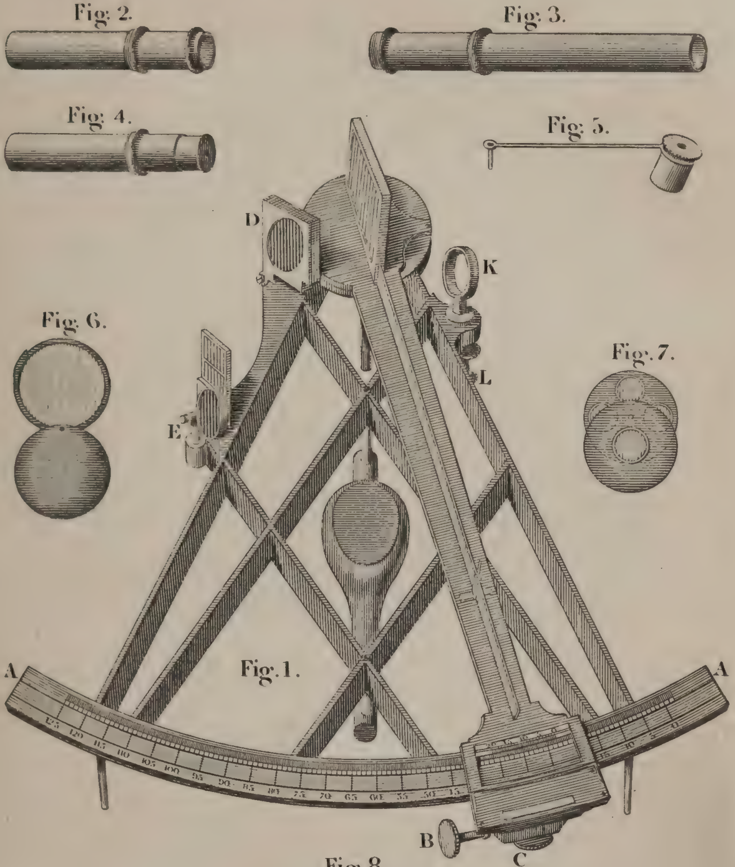


Fig: 2.

Fig: 3.

Fig: 4.

Fig: 5.

Fig: 6.

Fig: 7.

Fig. 1.

Fig: 8.

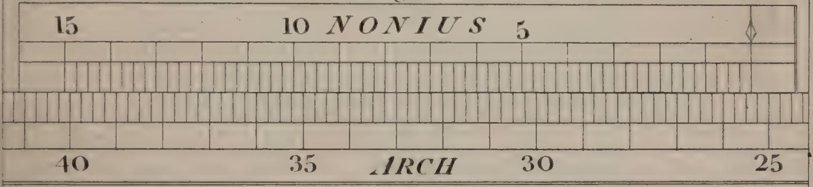
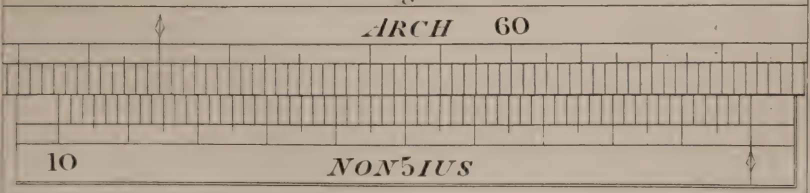


Fig: 9.



J. Dower Sculp.

Or if the 0 on the nonius of a sextant, divided as in figure 9, were placed between the third and fourth divisions to the right of 0 on the arch, and the fifth subdivision on the nonius, counting to the right from that marked 10, coincided with one on the arch, the whole arch would be 30 minutes and 50 seconds.

In order to observe with accuracy, and make the images come precisely in contact, an adjusting, or *tangent screw* B, is added to the index, by which it may be moved with greater regularity than it can be by hand; but it must be observed, this screw does not act until the index is fixed by the clamp or finger screw C, placed at the back of the sextant. Care should be taken not to force the tangent screw when it arrives at either extremity of its arch. When the index is to be moved any considerable quantity, the screw C must be loosened; but when the index is brought nearly to the division required, this back screw should be tightened, and then the index be moved gradually by the tangent screw.

Four shades, or coloured glasses, are placed at D, between the index and horizon-glasses, each of which is set in a different frame, turning on a centre: they are used to screen the eye from the brightness of the reflected solar image, and the glare of the moon, and may be used separately, or together, as occasion requires.

Three more such glasses are placed behind the horizon-glass at E, to weaken the rays of the sun or moon, when they are viewed directly through the horizon-glass. The pale glass is sometimes used in observing altitudes at sea, to take off the strong glare of the horizon.

The sextant is generally furnished with a plane tube (Fig. 2) without any glasses; and to render the objects still more distinct, it has likewise two telescopes, one representing the objects *erect*, or in their natural position (Fig 4); the other, a longer one (Fig. 3), which shews the objects *inverted*; but the latter has a larger field of view, and a greater magnifying power, with other advantages: a little use will soon accustom the observer to the inverted position, and the instrument will be as readily managed by it, as the plane tube alone. By a telescope the contact of the images is more perfectly distinguished; and by the place of the images in the field of the telescope, it is easy to perceive whether the sextant is held in the proper plane for observation. By sliding the tube that contains the eye-glasses in the inside of the other tube, the object is suited to different eyes, and made to appear perfectly distinct and well defined.

The telescope is to be screwed into a circular ring at K: this ring rests on two points, against an exterior ring, and is held thereto by two screws, by turning one, and tightening the other, the axis of the telescope may be set parallel to the plane of the sextant, as already directed. The exterior ring is fixed on a brass stem that slides into a socket; and by means of the screws at the back of the sextant, it may be raised or lowered, so as to move the centre of the telescope to point to that part of the horizon-glass which shall be judged the most fit for observation.

A circular head, with coloured glasses (Fig. 7), sometimes accompanies the sextant, and is to be screwed on the eye-end of the tube, or on that of either telescope. The glasses are contained in a circular plate, which has four holes; three of these are fitted with coloured glasses, the fourth is open. By pressing the finger against the projecting edge of this circular plate, and turning it round, the open hole, or any of the coloured glasses, may be brought between the eye-glass of the telescope and the eye.

To these appendages are added a small screw-driver, to adjust the screws; a magnifying-glass (Fig. 6), to read off the observation with greater accuracy; and a microscope (Fig. 5), for the same purpose, made to fit into a tube fixed at the lower end of the index.

ADJUSTMENTS OF THE SEXTANT.

To adjust a sextant is to set the index and horizon-glasses perpendicular to the plane of the instrument, and their planes parallel to each other when the index-division is at 0 on the arch; also, to set the axis of the telescope parallel to the plane of the instrument: each of these particulars must be examined before an observation is taken, and the adjustments, if requisite, made according to the following directions.

I. *To set the Index-Glass perpendicular to the Plane of the Sextant.*

Move the index forward to about 60 degrees; then, holding the instrument horizontally, with the limb from the observer, look obliquely down the index-glass, and see if the reflected and the true arches appear to be in the same plane; if they are, the glass is adjusted; otherwise, it is to be rectified by the screws behind the glass, as directed for the quadrant, page 176.

II. *To set the Horizon-Glass perpendicular to the Plane of the Sextant*

Screw on the plane tube, or the common telescope, and, holding the sextant horizontally, observe if the reflected and true horizons appear in the same strait line; if they do, the glass is adjusted; otherwise, turn the screw at the back of the instrument till they perfectly coincide. This adjustment may also be made by directing the telescope to the sun, moon, or a star, in which case make the index-division, or 0 on the nonius, coincide with 0 on the arch; then, holding the instrument perpendicularly to the horizon, direct the telescope to the object; if the reflected image be to the right or left of the direct object, turn the screw under the horizon-glass till they coincide with each other, when the glass will be perpendicular to the plane of the instrument. If the adjustment be made by a star, move the index backwards and forwards slowly, and observe if the reflected image, in passing the star, coincide with it; if it does not, the glass is to be adjusted by the screw, as before.

Horizon-glasses are fitted up in various ways, to admit of this adjustment. In some sextants a screw, connected with the brass frame of the horizon-glass, which moves on two points, is placed behind, over which a brass cap is screwed, to secure it from accidents; in others, a small screw is placed at the top of the frame, and is moved by a steel lever pin: by means of these screws the horizon-glass is set perpendicular to the plane of the instrument.

When this or the following adjustment is made by observing the sun, the inverting telescope is always to be used, and one or more of the shades, both before and behind the horizon-glass, are to be turned up, in order to screen the eye from the bright solar rays proceeding from the direct and reflected suns; which are to be made, by means of the shades, to appear as nearly as possible of the same degree of brightness.

III. *To set the Horizon-Glass parallel to the Index-Glass, when the Index Division is at* 0 *on the Arch.*

Make the index division of the nonius coincide exactly with 0 on the arch; and, in order to make the coincidence as perfect as possible, examine them through the magnifying glass, or microscope, and fix the index by the clamp under it; screw on the telescope, and turn the screw L, at the back of the instrument, till the line which separates the transparent and silvered parts of the horizon-glass, bisect the field of the telescope. Having done this, hold the sextant perpendicularly, and direct the sight through the telescope to the horizon; then, if the reflected and true horizons do not coincide, turn the tangent screw at the back of the horizon-glass till they be made to appear in the same strait line: then will the planes of the horizon and index-glasses be parallel.

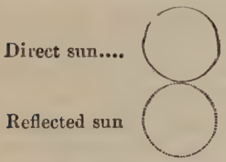
This adjustment, in some instruments, is made by means of two screws placed near the horizon-glass, which act against each other in turning the frame round its axis: these screws are moved by a steel lever-pin, put into one of the holes made through the head of the screw; and in making the adjustment by these screws, care must be taken, that when one is slackened, the other must be tightened, in order that they may sufficiently press against each other, and prevent the horizon-glass from altering its position, when the direct and reflected horizons are made to coincide. But although the adjustment made by these screws is not so liable to alter as when made by a tangent screw, it is recommended not to depend on this adjustment, but rather to find the *index error;* and indeed this becomes absolutely necessary when the horizon-glass is so constructed as not to admit of the adjustment, which is the case with most modern instruments

To find the Index Error.

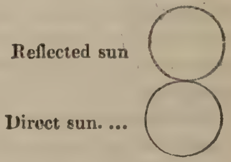
The *index error* is the number of minutes and seconds pointed out by the nonius, when the direct object and its reflected image coincide with each other, and may be found as directed in the adjustment of the fore horizon-glass of the Quadrant, in page 177; but with greater accuracy by the following method:—

Having screwed on the inverting telescope, adjusted the eye-tube to distinct vision, and turned up the proper shades, place the 0 on the nonius about 40 minutes to the *right* of 0 on the arch, and tighten the clamp c under the index of the sextant; then, holding the instrument perpendicularly, bring the direct and reflected suns in exact contact by the tangent screw, and read off the minutes and seconds pointed out by the nonius on the *arch of excess*, which note down, and call it *off;* next place the 0 of the nonius about 40 minutes to the *left* of 0 on the arch, and make the contact of the two suns correct, as above; read the minutes and seconds shewn by the nonius, which call *on*, and set it under the first arch; then half the difference of these two arches will be the index error, which is *additive* to all angles taken with the sextant, when the arch to the right of 0 is greater than the arch to the left of 0, and *subtractive* when the contrary. The direct and reflected suns will appear through the inverted telscope thus—

When the index-division is to the right of 0 on the arch.



When the index-division is to the left of 0 on the arch.



Suppose the following observations were taken, to determine the index error:

EXAMPLE I.

		′	″
Off......	+	31	45
On......	−	33	0
	2)	1	15
	−	0	37

Index error 0′ 37″ subtractive, because the arch to the left, or *on*, is greater than the arch to the right of 0.

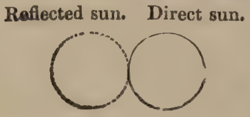
EXAMPLE II.

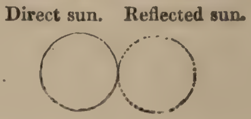
		′	″
Off	+	32	10
On.......	−	31	20
	2)	0	50
	+	0	25

Index error 25″ additive, because the arch to the right, or *off*, is greater than the arch to the left of 0.

To prove that the contacts were made correctly, add the arches together, and divide their sum by 4; the quotient should then be equal to the sun's semidiameter, as given in Page II. of the given month in the Nautical Almanac: Thus, suppose the observations in Example I. were made on February 2 th, 1858: here the sum of the arches is 64′ 45″, the fourth part of which is 16′ 11″, agreeing nearly with the sun's semidiameter (16′10″.8) as given on that day in the Nautical Almanac; it may therefore be presumed that the contacts were correctly made.

But if the altitude of the sun should be less than about 20° at the time of taking the above observations, the sun's horizontal, instead of the perpendicular, diameter should be measured; for as refraction affects the lower limb more than the upper, it occasions the perpendicular diameter to be less than the horizontal, which is that given in the Nautical Almanac: in this case, the sextant is to be held horizontally, with the face upwards, and the reflected sun brought into contact alternately with the right and left limbs of the direct sun, as before explained; the contacts will then appear thus—





IV. *To set the Axis of the Telescope parallel to the Plane of the Sextant.*

In measuring angular distances, the line of sight, or axis of the telescope, should be parallel to the plane of the instrument, as a deviation in that respect may occasion a considerable error in the observation, and this is most sensible in large angles; to avoid which, a telescope is made use of, in whose field there are placed two wires parallel to each other, and equidistant from the centre, to which are generally added two others at right angles to these, and parallel to each other. By means of these wires, the adjustment may be made thus: screw on the telescope, and turn the tube containing the eye-glass till two of the wires are parallel to the plane of the instrument; then take two objects, as the sun and moon, or the moon and a star, or two stars, whose angular distance must not be less than 90 degrees, because the error is more easily discovered when the distance is great: bring them exactly into contact at the wire which is nearest the plane of the sextant, and fix the index; then, by altering a little the position of the instrument, make the objects appear on the other wire. If the contact still remain perfect, the axis of the telescope is in its right situation; but if the limbs of the two objects appear to separate at the wire that is farthest from the plane of the instrument, it shews that the object-end of the telescope inclines towards the plane of the instrument, which must be rectified by tightening the screw nearest the sextant, which is attached to the ring that holds the telescope, having previously slackened the screw farthest from it. If the images overlap each other at the wire farthest from the sextant, the object-end of the telescope is inclined from the plane of the sextant, and the highest screw must be turned towards the right, and the lowest towards the left. By repeating this observation a few times, the contact will be precisely the same at both wires, and consequently the axis of the telescope will be parallel to the plane of the instrument.

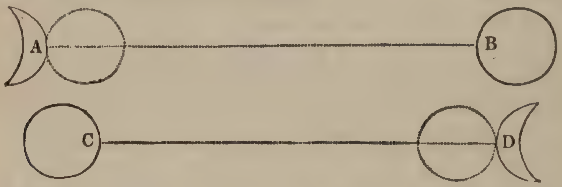
USE OF THE SEXTANT.

To observe the angular Distance between the Moon and the Sun

Turn up one or more of the shades before the horizon-glass, according to the brightness of the sun, and set the index division to 0 on the arch; then, holding the plane of the sextant so as to pass through the two objects, with its face upwards, when the sun is to the right-hand of the moon, or downwards, when the sun is to the left (see Diagrams in the following page), direct the sight through the ring K and the horizon-glass, to the moon, without using the telescope, and move the index forward until the sun's image come nearly in contact with the moon's nearest limb; then fix the index by the screw C under the sextant. Now screw on the *inverting* telescope, adjusted to distinct vision, placing two of the wires parallel to the plane of the instrument, and raising the telescope, by the screw L, to the transparent part of the horizon-glass; then, directing the sight through the telescope to the moon, holding the sextant as before directed, make the contact perfect by means of the tangent screw B; at the same time moving the sextant slowly round the axis of the telescope, by which means the sun will appear to pass by the moon, and the contact be more accurately made; observing always, that the point of contact of the limbs should be as near the centre of the field of the telescope as possible.

The arch pointed out by the nonius being now read off, as before directed, will shew the observed distance of the nearest limbs of the sun and moon.

In the following Diagrams, A B represent the observed distance of the nearest limbs when the sun is to the right of the moon, and C D the distance when the sun is to the left of the moon.



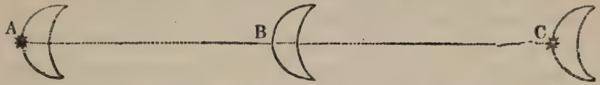
It will perhaps be more easy for those who are not accustomed to take observations, to find the distance nearly, and setting the index forward to it, to look directly towards the moon, holding the instrument as before; the sun will then appear nearly in contact with it, and is to be made perfect by the method above mentioned. In the Nautical Almanac, the distances of the sun and moon are set down for the beginning of every third hour of time at Greenwich, on such days as the moon is not less than 35 degrees, nor more than 125 degrees from the sun, and may be found for any intermediate time by proportion. From these distances you may compute roughly their distance at the time of observation, thus: calculate roughly the time at Greenwich, when the observation is to be taken, as directed in Page 155; then find by the Ephemeris the distance nearly at that time, from which subtract 30 minutes, the sum of the semidiameters, and the remainder will give the distance of their nearest limbs at the time of observation.

It will save some trouble, and serve the purpose of finding the reflected image of the sun or moon in the horizon-glass, if you only set the index to the central distance, as set down in the Almanac for the nearest third hour, without correcting it to the intermediate time by a rough computation.

To observe the Distance between the Moon and a Star or Planet.

Turn up one of the lightest screens before the horizon-glass, and, without the telescope, direct the sight through the ring K, and the horizon-glass, to the star; holding the sextant in such a direction that if its plane be seen edgewise, it may appear to pass through the moon and the star, with its face upwards or downwards, according as the star is to the left or right of the moon; then move the index forward, until the reflected image of the moon be seen near to the star. Now screw on the inverting telescope, and adjust it as before directed; bring the *enlightened* edge of the moon into contact with the star, by means of the tangent screw, at the same time moving the arch of the sextant slowly up and down, by which motion the enlightened limb of the moon will appear to pass the star, and the contact be more accurately made, which should always be as nearly as possible to the centre of the field of the telescope. The arch being then read off, will give the observed distance between the star and the moon's enlightened limb.

In the following Figure, A B represent the distance of the star at A from the moon's nearest limb at B, and B C the distance of the moon's furthest limb from the star at C.



If the distance between the moon and one of the stars set down in the Almanac, for finding the longitude, is to be observed, their distance may be roughly calculated, as before directed, to which set the index; then look through the telescope, and direct the sight to the star; which is generally a bright one, and lies in a line nearly perpendicular to the horns of the moon, either to the eastward or westward, as denoted in the Almanac; and, holding the sextant in the plane of the two objects, give it a slow motion round the axis of the telescope, and if the moon's image come into the field of the telescope, it is a proof you have taken the right star, as no other in that direction will correspond to it in distance.

In this manner the distance of the moon from a planet is to be observed; but the moon's enlightened limb is always to be brought over to the *centre* of the planet.*

ON THE ARTIFICIAL HORIZON.

When altitudes are to be taken on shore with a sextant, where the observer has not the advantage of the sea horizon, he is obliged to have recourse to an artificial horizon, which is a horizontal plane with a smooth or polished surface, on which the rays of the sun, or other object, falling, are reflected back to an eye placed in a proper position to receive them: the angle between the real and reflected objects being then measured with a sextant, will be double the altitude above the horizontal plane.

Such a horizontal plane may be obtained by pouring a quantity of oil, tar, treacle, or other fluid and viscous substance, into a shallow vessel; and, to prevent the wind giving a tremulous motion to its surface, a piece of thin gauze, muslin, or plate-glass, whose surface is perfectly plane and parallel, may be placed over it when used for observation.

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* A star is a mere luminous point, having no sensible diameter; but that of a planet amounts to a few seconds. If the distance be taken as directed above, the necessity of allowing for the planet's semidiameter will be avoided in clearing the distance.

An artificial horizon sometimes consists of a plane speculum, fixed in a brass frame, standing upon three adjusting screws, by which its surface may be made horizontal with the assistance of a spirit-level placed on its surface in various positions; observing that the screws be turned until the air-bubble always rests in the middle of the tube. The under surface of the plate of glass is sometimes unpolished and blackened, so that the image of the sun can only be reflected from the upper surface, which should be carefully polished, and a perfect plane by this means the errors that might arise from a defect of parallelism in the two surfaces are avoided.

But the best and most approved kinds of artificial horizons are those produced by quicksilver, which being poured into a small wooden trough, will always, agreeably to the nature of fluids, preserve an exact horizontal plane at its surface: over this is placed a roof, to protect the quicksilver from the action of the wind; in which are fixed two plates of glass, the two sides of each being ground perfectly plane and parallel. These are usually packed in a mahogany box, with a vessel containing a quantity of quicksilver, ready for use when wanted.

When one of these instruments is used, the observer is to place himself at a convenient distance, for instance, two or three feet, in such direction as that he may see the object reflected from the artificial horizon, as well as the real object; then, having screwed on the telescope of the sextant, and turned down the dark glasses before and behind the horizon-glass, the upper or lower limb of the sun's image, reflected from the index-glass, is to be brought into contact with the opposite limb of the image reflected from the artificial horizon, observing that when the inverted telescope is used, the upper limb will appear as the lower, and *vice versâ**. the angle on the instrument being then read off, and the index error applied to it, will give double the altitude of the limb above the horizontal plane; to the half of which, if the refraction, parallax, and semidiameter be applied, the result will be the true altitude of the centre.

Example. Suppose, August 12, 1862, the observed angle between the lower limb of the sun, reflected from the index-glass of the sextant, and the upper limb reflected from the artificial horizon, to be 99° 45′ 30″, the index error of the sextant being 2′ 20″ to add: required the true altitude of the sun's centre.

	°	′	″
Observed angle..................................	99	45	30
Index error..	+	2	20
2)	99	47	50
Observed altitude of sun's lower limb....	49	53	55
Refraction—Parallax (Table XVIII.)....	—		42
True altitude of sun's lower limb	49	53	13
Sun's semidiameter..............................	+	15	50
True altitude of sun's centre................	50	9	3

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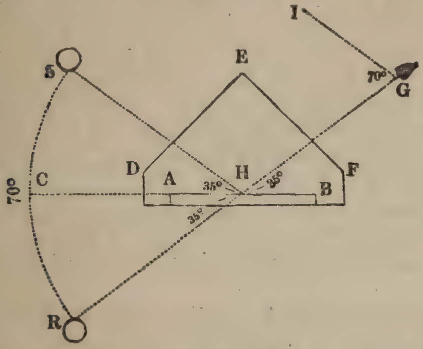
* It will perhaps be more easy to the observer, if he first bring the images of the sun nearly into contact by the naked eye, and afterwards screw on the telescope, and make the contact perfect by the tangent-screw.

The following diagram will illustrate the method of observing altitudes with an artificial horizon:



Let A B represent the surface of the quicksilver, contained in a wooden trough, whose plane is continued to C; D E F, the roof, in which are fixed two plates of glass, D E and E F, whose surfaces are plane and parallel to each other; and ○ the sun at S., whose altitude is required. Now the ray S H, proceeding from the sun's lower limb to the surface of the quicksilver, will be reflected thence to the eye, in the direction H G, and the upper limb of the sun's image, reflected from the quicksilver, will appear in the line G H, continued to R; and it is a well-known principle in catoptrics, that the angle of incidence S H A or S H C, is equal to the angle of reflection G H B; and as the angle A H R or C H R is vertical, or opposite to the angle G H B, it is therefore equal to it, and to the angle S H C: consequently the angle S H R is double the angle S H C, the altitude of the sun's lower limb above the horizontal plane; so that if we suppose the angle S H R, measured by a sextant, to be 70°, the altitude of the sun's lower limb will be 35°.

In theory, the eye of the observer should be placed at the angular point H; but as a ray I G, proceeding from so distant an object as the sun to the eye at G, may be considered as parallel to the ray S H, the measured angle I G H will be equal to the angle S H R.

ON FINDING THE

LONGITUDE BY OBSERVATION.

Various methods have been proposed for determining the longitude of a place, but almost all of them depend upon one general principle, *viz.* the comparison of the relative times under two different meridians; so that if the time under a given meridian be known, and also the time under any other meridian, the difference of these times, turned into degrees and minutes, in the proportion of 15 degrees to 1 hour, will be the difference of longitude between the two meridians. For as the sun apparently moves round the earth, from east to west, in 24 hours, or over an arch of 15 degrees of the equator in 1 hour of time, all places lying to the eastward of any meridian, will have noon sooner, or if to the westward, later, by as much time as the sun takes to pass from the meridian of one place to the meridian of the other: hence, if the time at the meridian of Greenwich (from whence the longitude is reckoned), and of any other place, at the same moment o absolute time, be given, its longitude from Greenwich may be inferred by reducing the difference of the times into degrees and minutes, in the proportion of 15 degrees of longitude to 1 hour of time: moreover, if the time at the place be greater than that at Greenwich, its longitude will be east, but if less, it will be west. Thus, suppose it is ascertained that the time at Greenwich is 2 hours past noon when it is just noon at the ship; it will thence appear that the longitude of the ship is 30° west of the meridian of Greenwich, because the sun passes over 30° of the equator in 2 hours of time, and having left the meridian of Greenwich 2 hours since, the ship must consequently be to the westward of that meridian. If we suppose the time at the ship to be 2 hours past noon when it is noon at Greenwich, her longitude would be 30° east of the meridian of Greenwich; for the sun in this case would have passed the meridian of the ship 2 hours before he passed that of Greenwich.

Now the time at any given meridian may be easily computed by an altitude of the sun or other celestial object, taken when distant from the meridian, or from observations of the sun when at equal altitudes; and the time at Greenwich may be ascertained by means of a chronometer, or by various astronomical observations. With respect to the first of these, it is obvious that if a clock or watch could be so constructed as to go uniformly in all seasons, and at all places, such a machine being once set to mean time at Greenwich, would always shew the mean time at that meridian, on whatever part of the earth it might be; and therefore, if the mean time under any other meridian were found, and compared with that shewn by the chronometer the longitude of the place from Greenwich would be readily obtained. To effect this purpose, several ingenious artists have exerted their abilities, and have brought chronometers to an astonishing degree of perfection, whereby they have become a valuable acquisition to the navigator, in determining the difference of longitude made in short periods: however, considering the delicacy of their construction, and the various accidents to which they are liable, an implicit confidence ought not to be placed on them alone, particularly in long voyages; but recourse should be had to astronomical observations, whenever opportunities present themselves.

The various astronomical methods of determining the longitude depend likewise upon the above-mentioned general principle; for, by observing the time at the meridian of a given place when any celestial appearance happens, and comparing the same with the time at Greenwich, as shewn by the Nautical Almanac*, their difference, reduced to degrees and minutes, gives the longitude of the place where the observation is taken. Suppose, for instance, that an eclipse of the moon should be observed at a certain place to begin at midnight, and that by the Almanac, the time at Greenwich, when the eclipse commenced, was 3 hours past midnight: now as the commencement of the eclipse must be seen at the same moment of absolute time in all parts where it is visible, the difference between the time at the place of the observer and that of Greenwich, which is 3 hours, and answers to 45 degrees, must be the longitude of the place; and it is evidently west, because the time at the place is less than the time at Greenwich. Upon the same principle the eclipses of Jupiter's satellites will give the longitude. But eclipses of the moon happen too seldom to be of use at sea; and the satellites of Jupiter are visible only through a telescope of considerable magnifying powers, which cannot be managed on board a ship.

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* The Nautical Almanac was originally proposed by the late Dr. Maskelyne, Astronomer Royal, and the first published was for the year 1769, by order of the Commissioners of Longitude; being constructed, calculated, and printed under the immediate inspection of Dr. M., and after his decease, continued annually, with additions, by Mr. Pond, the late Astronomer Royal, till the year 1833.

In 1834, this most important and useful Work, so essential to the Navigator and Astronomer, was published by order of the Lords Commissioners of the Admiralty, according to an improved plan, recommended by a Committee of the Astronomical Society; and is now conducted under the superintendence of Professor J. R. Hind and Richard Farley, F. R. A. S.

All the calculations in the New Nautical Almanac are set down for *mean time*, at the meridian of Greenwich, excepting those in Page I. of each month, which are computed for *apparent time*. In the latter part of the Work is given a clear and copious explanation of all the articles contained therein, which renders any further explanation here unnecessary.

The most practical method of ascertaining the time at Greenwich by celestial observations taken at sea, is that of measuring the angular distance between the moon and sun, or the moon and certain stars or planets near the ecliptic, usually called a *lunar observation*, both on account of the quick motion of the moon in her orbit, and the frequent opportunities that offer for taking such observations; for in favourable weather, distances may be taken at all times when the objects are more than 9 or 10 degrees above the horizon, except about the time of new moon; and, as the moon's daily motion is about 13 degrees, or at the rate of 1 minute of a degree in two minutes of time, if her true angular distance from the sun, a star, or a planet can be ascertained within 30″ of a degree, the corresponding time at Greenwich will be known within one minute of time, and hence the longitude within 15 minutes of a degree.

This method of determining the longitude was proposed many years ago by Mr. John Werner and others; but, from want of proper instruments to observe the distances, and of a good lunar theory to ascertain the moon's place, it was laid aside. These difficulties are, however, now happily obviated by the invention and improvements of Hadley's Sextant, and the accuracy of the new Lunar Tables; so that a good observer, with proper instruments, may depend upon the longitude found by this method within a few minutes of a degree.

To facilitate this important problem, the true angular distances between the centres of the moon and the sun, a fixed star, or planet,* are set down in Pages XIII. to XVIII. of each month in the Nautical Almanac, for the beginning of every third hour of Greenwich mean time; and the time answering to any intermediate distance, may be found by proportional parts:

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* The Stars used in the Nautical Almanac for the above purposes are, α *Arietis*, *Aldebaran*, *Pollux*, *Regulus*, *Spica Virginis*, *Antares*, α *Aquilæ*, *Fomalhaut*, and α *Pegasi*. As a knowledge of these stars is of great importance to the observer, the Author has published a Set of Celestial Maps, with directions for using them, in which the above stars are particularly pointed out, and may be more readily known by comparing the maps with the heavens, than they possibly can by any verbal description.

The *Planets* from which the moon's distances are computed, are *Venus*, *Mars*, *Jupiter*, and *Saturn*; these distances were formerly published by Professor Schumacher, at Copenhagen, but are now introduced into the new Nautical Almanac among the other distances, being calculated under the direction of Professor J. R. Hind and Richard Farley, F. R. A. S.

hence the distance between these objects being taken with a sextant or circle and the corresponding mean time at Greenwich found by the Almanac, and compared with the mean time at the ship, their difference will be the longitude of the place of observation.

But since the observed distance is always taken from the surface of the earth before it is compared with the true distances in the Almanac, it must be corrected, in order to find what it would have been if observed at the centre, to which point the true distances are referred; for, by the effects of parallax and refraction, the moon is seen lower than its true place, and the other objects higher: hence the true is almost always different from the observed distance.

In taking a *lunar observation*, two assistants should be employed to observe the altitudes of the objects, while the principal observer is taking their distance; also one with a watch, to mark the times when the observations were made. If one of the objects be at a proper distance from the meridian, the time may be inferred from its altitude; but if it be too near the meridian, a watch or chronometer will be absolutely necessary, whose error must be found by an altitude taken before or after the lunar observation, according as it is most convenient.

The quadrants and sextant being properly adjusted, and their index errors found, place the assistants in the most convenient situation, and let the one holding the watch be provided with a paper and pencil, to note down the observations when taken. All things being ready, proceed to take the distance between the objects, the assistants at the same time observing the altitudes of each. When this is done, give notice to the assistant with the watch, who is to mark the exact time, and set it down, together with the observations read off from the instruments. In this manner proceed four or five times, each set of observations being noted down in proper order; then take the mean of the times, and of each observation, by adding them together, and dividing their sum by the number of sets observed; the quotient will give the mean of each set, which is much more to be depended upon than if one set only were taken.

The following example will shew the form in which a set of lunar observations are to be written down:

June ——— Height of the eye 20 feet.

	Times by watch.			Alt. of * Antares.			Alt. of ☽'s L. L.			Dist. ☽'s far. L.			
	h.	m.	s.	°	′	″	°	′	″	°	′		
	9	21	0	26	51	0	41	45	30	62	26	53	
		22	20	27	0	0	41	33	0		26	12	
		23	5	27	4	0	41	25	30		25	51	
		24	15	27	12	0	41	14	30		25	14	
		26	0	27	24	0	40	58	0		24	25	
	5)	116	40	135	31	0	206	56	30		128	35	
Means........	9	23	20	27	6	12	41	23	18	62	25	43	
Err. of watch.	+		10	−	1	0	+	1	15	−		10	Ind.Errs.
	9	23	30	27	5	12	41	24	33	62	25	33	

It may sometimes happen that, from want of proper assistants, the altitudes of the two objects cannot be taken at the same time with their distance; in which case the altitudes may be inferred from the apparent time and the latitude of the ship, according to rules laid down for that purpose; but it must be observed, that unless these be well determined, the operation will bring out a considerable error: it will therefore be found much more accurate to adopt the following method, by which one person can take a set of observations without assistants, having a good quadrant to take the altitudes, and a sextant to observe the distances.

Let the observations be taken in the following order, noting the times by a watch: 1, the altitude of the sun, star, or planet; 2, the altitude of the moon; 3, any odd number of distances; 4, the altitude of the moon; 5, the altitude of the sun, star, or planet. Now add together the distances, and the times when they are taken, each of which being divided by the number observed, will give the mean of the times and distances; then, to reduce the altitudes to the mean of the times, say, as the difference of times between the observations is to the difference of their altitudes, so is the difference between the time that the first altitude was taken, and the mean of the times, to a fourth number; which, added to, or subtracted from, the first altitude of each object, according as it is increasing or decreasing, will give the altitudes reduced to the mean of the times.*

EXAMPLE.

Suppose the following observations were taken at the under-mentioned times: required the altitudes of the sun and moon, reduced to the mean of the times and distances.

	Times per watch.					
	3h. 25m.41s.	Alt. of sun's lower limb.........	54°	5′	0″	
	28 44	Alt. of moon's upper limb	20	3	0	
Mean of the times 3h 33m. 47s.	32 50	Dist. nearest limbs...............	73	13	30	Mean dist. 73° 14′ 3″
	33 30	Dist. nearest limbs...............	73	14	10	
	35 0	Dist. nearest limbs...............	73	14	30	
	38 20	Alt. of moon's upper limb......	20	45	0	
	42 4	Alt. of sun's lower limb.........	53	14	0	

	Times.	Altitudes.	Times.	
1st alt.	3h. 25m.41s.	54° 5′	3h. 25m.41s.	1st altitude.
2d alt.	3 42 4	53 14	3 33 47	mean of times.
Diff....	16 23 ——	51 ——	8 6 —	0° 25′ 13″

First altitude of sun's lower limb 54 5 0

Reduced altitude of sun's lower limb .. 53 39 47

	Times.	Altitudes.	Times.	
1st alt.	3h. 28m.44s.	20° 3′	3h. 28m.44s.	1st altitude.
2d alt.	3 38 20	20 45	3 33 47	mean of times
Diff....	9 36 ——	42 ——	5 3 —	0° 22′ 6″

First altitude of moon's upper limb......... 20 3 0

Reduced altitude of moon's upper limb ... 20 25 6

Hence we obtain the following set of observations.

Time per watch.	Dist. nearest L. of ☉ & ☾.	Alt. of ☉'s L. L.	Alt. of ☽'s U.L.
3h. 33m. 47s.	73° 14′ 3″	53° 39′ 47″	20° 25′ 6″

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* The change of altitude may be readily found by Proportional Logarithms See Explanation to Table XXXIV

ON FINDING THE TIME AT ANY GIVEN MERIDIAN.

To find the apparent, or mean Time, at Ship or Place of Observation, and thence the Error of the Watch, by an Altitude of the Sun.

Rules.—1. With the estimated longitude, and apparent time at ship when the observation is taken, find the corresponding apparent time at Greenwich by the Rule in Page 155, to which apply the equation of time, taken out for the nearest noon from Page I. of the month in the Nautical Almanac, as directed at the head of its column: the result will be the corresponding mean time at Greenwich nearly. Or the Greenwich mean time may be found by a chronometer, whose error for that meridian is known.

2. From the observed altitude of the sun's lower limb subtract the dip of the horizon (V.), and the refraction (IV.), or the difference of refraction and parallax (XVIII.), and to the remainder add the sun's semidiameter, taken from Page II. of the Nautical Almanac; the sum will be the true altitude of the sun's centre. Or the correction for the dip, refraction, and semidiameter may be nearly found at once by Table IX.

3. Take out the sun's declination for the preceding noon at Greenwich, from Page II. of the Nautical Almanac, and correct it for Greenwich mean time by Table XXI. or Table XXXIII.†

4. Take out the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich time by the hourly difference on the given day.

5. Then proceed according to one of the following methods.

METHOD I.

1. Subtract the sun's declination from 90°, when the latitude and declination are of the same name; or add it to 90° when they are of contrary names; and the sum or remainder will be the sun's polar distance.

2. Add together the sun's true altitude, the polar distance, and the latitude of the place of observation; take the difference between half their sum and the sun's true altitude, and note the remainder:

3. Then add together,

The co-secant of the polar distance (XXV.);
The secant of the latitude;
The co-sine of the half sum;
And the sine of the remainder.

4. The sum of these four logarithms, rejecting tens in the index, will be the log. (XXXI.), answering to the *apparent time* from the nearest noon: consequently, if the observation be made in the morning, the time thus found must be taken from 24 hours, to obtain the apparent time from the preceding noon.

5. To the apparent time thus found, apply the reduced equation of time, by addition or subtraction, as directed at the head of its column in Page I. of the Nautical Almanac; and the sum or remainder wll be the *mean time* at the ship, or place of observation. Hence the error of the watch or chronometer, at the meridian of the place, may be found either for apparent or mean time.

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† Or the correction for reducing the declination to Greenwich mean time may be found by the *diff. for 1 hour*, in the Nautical Almanac.

METHOD II.

1. When the sun's declination, and the latitude of the place, are of the same name, take their difference, but when they are of contrary names, take their sum, under which set the sun's zenith distance*; take the sum and difference of these, also the half sum and half difference; then add together.

2. The log. secant of the latitude (XXV.);
The log. secant of the declination;
The log. sine of the half sum;
And the log. sine of the half difference.

The sum of these four logarithms, rejecting tens in the index will be the log. (XXXI.), answering to the apparent time from the nearest noon, as before.

This method of computing the apparent time will be found very convenient when it is required to work to the nearest second; since the proportional parts to seconds, being all additive, may be added at once with the logarithms, to find the required logarithm.

Note. The observations for finding the time should be taken when the sun, or any other celestial object, is at least three hours from the meridian; and the nearer it is to the east or west points of the horizon, the better; because then the change of altitude is quickest, and an error of a few miles in latitude will not materially affect the time.†

It will be proper to observe several altitudes, noting the times, by the watch or chronometer, when each is observed, and to use the means of the sets, which are found by adding the sets together, and dividing their sum by the number that are taken.

EXAMPLE I.

August 16, 1866, the following observations were made of the sun's lower limb, in latitude 36° 30′ N., and longitude by account 152° E., the height of the observer's eye being 20 feet: required the true apparent and mean time at the ship, and the error of the watch.

	App. Times by Watch. h. m. s.	Altitudes of Sun's L. L. ° ′
	4 40 0	24 20
	41 10	24 4
	42 5	23 50½
	43 0	23 36
	44 17	23 21½
5)	210 32	119 12
Means	4 42 6	23 50 24
Dip of horizon...		− 4 17
		23 46 7
Corr. (XVIII)...		− 2 0
		23 44 7
Sun's semidiam.		+ 15 50
Sun's true alt....		23 59 57

	h m.
App. time at ship, Aug. 16,	4 42
	24
App. time at ship. Aug. 15,	28 42
Longitude in time	10 8 E.
Green. app. time, Aug. 15,	18 34
Equation of time	+ 4
Greenwich mean time...	18 38 August 15.

	m. s.
Equat. of time. Aug. 15, (p. I. Naut. Alm.)	+ 4 16.70
H. diff. − 0 48 s. × $18\frac{2}{3}$ h. =	− 8.96
Eq. at Green. time	+ 4 7 74

	° ′ ″
Sun's declination, August 15, (p. II. N. A.) ...	14 3 43 N.
Hourly diff. − 46.87″ × $18\frac{2}{3}$ h. = 874.9″ = ...	− 14 35
Sun's declination at Greenwich mean time......	13 49 8 N.
	90
Sun's polar distance	76 10 52

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* The zenith distance is found by subtracting the altitude from 90°.

† The time from noon, or the altitude, when the sun or other celestial object is in the most advantageous position for finding the time at the place of observation, is given in Tables XLV. and XLVI.

METHOD I.

True altitude……	24° 0′			
Polar distance …	76 11	………Co-secant	0.01275	
Latitude ………	36 30	………Secant …	0.09482	
Sum ……………	136 41			
Half-sum ………	68 20½	………Co-sine…	9.56711	
Remainder ………	44 20½	………Sine ……	9.84443	
	h. m. s.			h. m. s.
Apparent time at ship ………	4 40 43	……Log ……	9.51911 ………………	4 40 43
Equation of time ……………	+ 4 8	……Time by Watch ………………		4 42 6
Mean time at ship …………	4 44 51	……Watch *fast* for apparent time………		1 23
Time by watch ………………	4 42 6			
Watch *slow* for mean time …	2 45			

METHOD II.

Latitude ………………	36° 30′ 0″ N.	……………… Secant	0.094821
Sun's declination ………	13 49 8 N.	……………… Secant	0.012752
			4[*]
Difference ………………	22 40 52		
Zenith distance …………	66 0 3		
		° ′ ″	58
Sum ………………………	88 40 55	Half 44 20 27…Sine…	9.844372
Difference ………………	43 19 11	Half 21 39 35…Sine…	9.566951
			185
	h. m. s.		
Apparent time at ship …	4 40 43.7	……………………Log…	9.51914.3
Equation of time ………	+ 4 7.8		
Mean time at Ship ……	4 44 51.5		

EXAMPLE II.

March 15, 1866 (*civil time*), the following observations of the sun's lower limb were made in latitude 16° 29′ N., and longitude 99° 30′ W., the height of the observer's eye being 22 feet, and the error of the sextant 2′ 50″ to be subtracted: required the apparent and mean time at the meridian of the ship, and the error of the watch.

	App. Times by Watch. h. m. s.	Altitudes of Sun's L. L. ° ′ ″
	18 42 52	10 28 45
	44 50	35 30
	46 44	44 15
	3) 134 26	108 30
	18 44 49	10 36 10
Index error …		− 2 50
		10 33 20
Cor(IX)+6′.6=		+ 6 36
Sun's true alt..		10 39 56
		90
☉'s zenith dist.		79 20 4

	h. m.
App. time at ship, March 14,	18 45
Long. 99° 30′ W. in time …	6 38
	25 23
	24
App. time at Greenwich……	1 23
Eq. of time (p. I. N. A.) …	+ 9
Mean time at Greenwich …	1 32 March 15.

	m. s.
Equation of time Mar. 15 (p. I. N. A)	9 6.27
H. diff. 0.71 s. × 1½ h. =	− 1.06
Equat. at Greenwich time……	9 5.21

	° ′ ″
Sun's declination, March 15, (p. II. N. A.) ……	2 6 21 S.
Hourly diff. − 59″.21 × 1½h. = 88″.81 = …	− 1 29
Sun's declin. at Greenwich mean time …………	2 4 52
	90
Sun's polar distance ……………… ……………	92 4 52

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[*] For the method of finding the proportional parts of seconds, see Explanation to Table XXV.

METHOD I.

	° ′		
True altitude	10 40		
Polar distance	92 5	Co-secant	0.00029
Latitude	16 29	Secant	0.01823
Sum	119 14		
Half-sum	59 37	Co-sine	9.70396
Remainder	48 57	Sine	9.87745
	h. m. s.		
Time from noon	5 12 56	Log	9 59993 (XXXI.,
	24		

			h. m. s.
Apparent time at ship	18 47 4		18 47 4
Equation of time	+ 9 5	Time by watch	18 44 49
Mean time at ship	18 56 9	Watch *slow* for apparent time	2 15
Time by watch	18 44 49		
Watch *slow* for mean time	11 20		

METHOD II.

	° ′ ″			
Latitude	16 29 00 N.		Secant	0.018226
Sun's declination	2 4 52 S.		Secant	0.000283
				4
Sum	18 33 52			
Zenith distance	79 20 4	° ′		106
Sum	97 53 56	Half 48 56 58	Sine	9.877340
Difference	60 46 12	Half 30 23 6	Sine	9.703964
				22
	h. m. s.			
Apparent time from noon	5 12 56.7		Log	9.59994.5 (XXXI.)

Having found the apparent time from noon, proceed as in the first method, to find the apparent and mean time, and thence the error of the watch.

To find the apparent and mean Time at Ship or Place of Observation, and thence the Error of the Watch, by an Altitude of a Star.

Rules.—1. With the estimated longitude and apparent time at ship, or by a chronometer, find the mean time at Greenwich, as directed in the last problem, Page 230.

2. From the observed altitude of the star, subtract the dip (V.) and refraction (IV.), or subtract the correction taken from Table XV., and the remainder will be the star's true altitude.

3. Reduce the star's right ascension and declination (XIII.) to the given year and month,* and the sun's right ascension, taken out for the preceding

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* In the Nautical Almanac for 1866, the true *apparent* right ascensions and declinations of the principal fixed stars (that is, their mean places corrected for the effects of precession, aberration, and nutation,) are given, from page 336 to 387 for every day, or tenth day of the month, and may be thence taken, instead of their mean places in Table XIII., in cases where the greatest accuracy is required.

noon from Page II. of the month in the Nautical Almanac, to the mean time at Greenwich (XXII. or XXXIII.), or by the hourly difference

4. Take out the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich mean time by the hourly difference on the given day.

5. Proceed as with the sun, by either of the methods in the last Problem, to find the hour-angle, or star's distance from the meridian (which, with the sun, is the time from noon); this being *added* to the star's right ascension if the star be to the *westward* of the meridian*, or *subtracted* from it, if the star be to the *eastward*, the sum or remainder will be the right ascension of the meridian.

6. From the right ascension of the meridian (increased by 24 hours if necessary) subtract the sun's reduced right ascension; and the remainder will be the apparant time of observation at the meridian of the ship.

7. To the apparent time thus found, apply the reduced equation of time, by addition or subtraction, as directed at the head of its column in Page I. of the Nautical Almanac; and the sum or remainder will be the mean time at the ship, or place of observation. Hence the error of the watch or chronometer, at the meridian of the place, may be found either for apparent or mean time.

EXAMPLE I.

January 5, 1866, in latitude 18° 18′ N., and longitude by account 55° 45′ West, the following altitudes of the Star Procyon were taken, when it was (*west of the meridian*), the observer's eye being 20 feet above the surface of the sea: required the apparent and mean time at the ship, and thence the error of the watch.

App. Times by Watch. h. m. s.	Altitudes of the Star. ° ′
16 41 30	26 13
45 10	25 14
48 25	24 29
54 30	22 47
59 13	21 17
5)248 48	120 0
16 49 45	24 0

	h. m. s.
Apparent time at ship ...	16 49 45
Long. 55° 45′ in time (XIX.)	3 43 0 W.
Apparent time at Green.	20 32 45
Equation of time	+ 6 6
Mean time at Greenwich	20 38 51

	° ′ ″
Star's obs. altitude....	24 0 0
Dip of horizon	− 4 17
	23 55 43
Refraction...............	− 2 8
Star's true altitude ...	23 53 35

	h. m. s.
Sun's R. Ascen., Jan. 5...	19 5 7
Cor. for 20h. 39m. (XXII.)	+ 3 47
Sun's R. A. at Green. time	19 8 54

	m. s.
Equat. of time, Jan. 5,	5 42.50
H. df. + 1s.11 × $20\frac{2}{3}$h =	+ 22.94
Eq. at Green. time ...	6 5.44

	h. m. s.
Star's right ascen. Jan. 1860 (XIII.)	7 31 58
Ann. var. + 3s. 15 × 6 = 18s. 9 =	+ 19
Star's right ascension, Jan. 1866†...	7 32 17

	° ′ ″
Star's declin., Jan. 1860 (XIII.)	5 34 51 N.
Ann. var. − 8″.77 × 6 = 52″.62 =	− 53
Star's declination, Jan. 1866‡...	5 33 58
	90
Star's polar distance..............	84 26 2

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* The time of the principal stars passing the meridian will be found in Table XLIV.

† Procyon's right ascension, taken from page 350 of N. A. on given day, is 7h. 32m. 19s.

‡ Procyon's declination, taken from page 350 of N. A., will be found 5° 33′ 46″ N.

METHOD I.

	° ′		
Star's true altitude...	23 54		
Polar distance........	84 26	...Co-secant	0.00205
Ship's latitude........	18 18	...Secant ...	0.02254
Sum	126 38		
Half-sum........	63 19	...Co-sine...	9.65230
Remainder	39 25	...Sine ...	9.80274
	h. m. s.		
Star's distance from meridian	4 26 33 W.	...Log......	9.47963 (XXXI.)
Star's right ascension........	7 32 17		
Right ascension of meridian	11 58 50		
	24		
	35 58 50		
Sun's right ascension........	19 8 54		h. m. s.
Apparent time at ship	16 49 56	....	16 49 56
Equation of time........	+ 6 5	Mean of times by watch	16 49 45
Mean time at ship	16 56 1	Watch *slow* of app. time	0 11
Mean of times by watch	16 49 45		
Watch *slow* for mean time	6 16		

EXAMPLE II.

April 22, 1866, in latitude 42° 10′ N., when a chronometer, which was 5m. 16s. *fast* for Greenwich mean time, shewed 9h. 8m. 46s., the observed altitude of the star Arcturus (*eastward of the meridian*) was 36° 54′; the error of the instrument being 3′ 0″ to add, and the height of the observer's eye 24 feet; required the apparent and mean time at ship, and thence the error of the chronometer.

	h. m. s.		h. m. s.
Mean time by chronometer	9 8 46	Sun's right ascen. (p. II. N.A.) April 22	1 59 43
Chronometer *fast*........	− 5 16	Correction for 9h. 3m. (Table XXII.) ...	+ 1 24
Mean time at Greenwich...	9 3 30	Sun's right ascen. at Greenwich time ...	2 1 7
	° ′		h. m. s.
Star's observed altitude	36 54	Star's right ascen., Jan. 1860 (XIII.) ...	14 9 17
Index error to add	+ 3	Ann. var. + 2s. 73 × 6⅓ = 17s. 29 =...	+ 17
	36 57	Star's right ascension, April, 1866*......	14 9 34
Correction from Table XV. ...	− 6		° ′ ″
Star's true altitude........	36 51	Star's declination, Jan. 1860 (XIII.) ...	19 54 47 N.
		Ann. var. − 18″. 92 × 6⅓ = 119″. 83 =	− 2 0
	m. s.		
Equation of time, April 22	1 32.34	Star's declination, April, 1866†	19 52 47 N.
Hourly diff. + 0s. 50 × 9h. =	+ 4.50		90
Equation at Green. time ...	1 36.84	Star's polar distance	70 7 13

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* Arcturus right ascension, taken from page 363 of N. A., is 14h. 9m. 35s.

† Arcturus declination, taken from page 363 of N. A., is 19° 52′ 45″ N.

METHOD I.

	° ′		
Star's true altitude	36 51		
Polar distance	70 7	Co-secant.	0.02669
Latitude	42 10	Secant	0.13007
Sum	149 8		
Half-sum	74 34	Co-sine	9.42507
Remainder	37 43	Sine	9.78658
	h. m. s.		
Star's distance from meridian	3 51 12 E.	Log	9.36841 (XXXI.)
Star's right ascension	14 9 34		
Right ascension of meridian	10 18 22		
Sun's right ascension	2 1 7		h. m. s.
Apparent time at ship	8 17 15		8 17 15
Equation of time	− 1 37	Time by chronometer	9 8 46
Mean time at ship	8 15 38	Chronometer *fast* for apparent time	51 31
Time by chronometer	9 8 46		
Chronom. *fast* for mean time	53 8		

To find the apparent and Mean Time at Ship, or place of Observation, and thence the Error of the Watch or Chronometer, by an Altitude of a Planet.

Rules.—1. With the estimated longitude and apparent time at ship, or by a chronometer, find the mean time at Greenwich by the Rule in Page 230.

2. From the observed altitude of the planet, subtract the dip (V.) and refraction (IV.), and to the remainder add the parallax in altitude (XLVIII); the result will be the true altitude of the planet.

3. Take the sun's right ascension from Page II. of the Nautical Almanac for the preceding noon, and reduce it to the mean time at Greenwich (XXII. or XXXIII.), *or by the hourly difference* from the N. A.

4. Reduce the right ascension and declination of the planet taken from the Nautical Almanac, to the mean time at Greenwich. (See Note at the top of Page 185).

5. Take the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich mean time, by the hourly difference on the given day.

6. Proceed as with the sun, by either of the methods given in Pages 230, 231, to find the planet's meridian distance, and thence compute the apparent and mean time at ship, as directed by the Rules for a Star, in Page 234.

EXAMPLE I.

August 5th, 1866, in latitude 32° 16′ S., and longitude by account 123° 00′ W., at 16h. 0m. apparent time by watch, suppose the altitude of the Planet Mars' centre to be 42° 58′ 30″ (*Eastward of the meridian*), the height of the observer's eye being 18 feet: required the apparent and mean time at ship, and from thence the error of the watch.

	h. m.		° ′ ″		h. m. s.
App. time ship, Aug. 5	16 00	Mars' obs. altitude..	42 58 30	Sun's R. A August 6..	9 4 48
Long. 123° 0′ in time	8 12W.	Dip of horizon (V.)..	− 4 4	Hour.diff. +9s.59×18m.=	+ 3
App. time at Green..	24 12		42 54 26	Sun's R.A. at Green. time	9 4 51
	24	Refraction (IV.) ..	− 1 1		
					m. s.
Ditto August 6	0 12		42 53 25	Equation of time, Aug. 6,	5 37.58
Equation of time....	+ 6	Par. in alt. (XLVIII.)	+ 4	Hour.diff. −0s.27×18m.=	− 0.08
Mean time at Greenwich, Aug. 6	0 18	Mars' true altitude	42 53 29	Equation at Green. time	5 37.50

	h. m. s.			° ′ ″	
Mars' R. A. Aug. 6 ..	4 27 16	(p.270, N.A.)	Mars' dec. Aug. 6 ..	21 8 17N.	(p.270, N.A.)
Mars' R. A. Aug. 7 ..	4 30 3		Mars' dec. Aug. 7 ..	21 15 15N.	
Variation in 24 hours	2 47	..Log. 0.9356	Variation in 24 hours	6 58	.. Log. 0.5372
Greenwich mean time	0h. 18m.	..Log. 1.9031	Greenwich mean time	0h. 18m.	.. Log. 1.9031
	h. m. s.			° ′ ″	
Variation in 0h. 18m..	+ 0 2	..Log. 2.8387	Variation in 0h.18m.	+ 0 5	.. Log. 2.4403
Mars' R. A. Aug. 6 ..	4 27 16		Mars' dec. Aug. 6..	21 8 17 N.	
Mars' R. Ascen. at Greenwich time ..	4 27 18		Ditto at Green. time	21 8 22 N.	
				90	
			Mars' polar distance	68 51 38	

	° ′		
Mars' polar distance..........	68 52	............Co-secant	0.03024
Ship's latitude	32 16	............Secant ..	0.07285
Mars' true altitude	42 53½		
Sum	144 1½		
Half-sum....................	72 1	.. ..Co-sine ..	9.48959
Remainder	29 7½	.............Sine	9.68727
	h. m. s.		
Mars' distance from the meridian	3 27 3 E.	....Log.	9.27995 (XXXI.)
Mars' right ascen. at Greenwich time	4 27 18		
Right ascension of the meridian..........	1 0 15		
	24		
	25 0 15		
Sun's right ascen. at Greenwich time	9 4 51		h. m. s.
Apparent time at ship	15 55 24	....	15 55 24
Equation at Greenwich time	+ 5 38	Time by the watch............	16 0 0
Mean time at ship	16 1 2	Watch *fast* of apparent time ..	4 36
Time by the watch......................	16 0 0		
Watch *slow* of mean time	1 2		

EXAMPLE II.

August 12, 1866, P. M., ship time, in latitude 27° 28′ N., when a chronometer which was 10m. 48s. *slow* of Greenwich mean time, showed 12h. 54m. 50s. P. M., suppose the observed altitude of the Planet VENUS' centre to be 26° 28′ 30″ (*Westward of the meridian*), the error of the sextant being 2′ 10″ to subtract, and the height of the observer's eye 24 feet: required the apparent and mean time at the ship, and thence the error of the chronometer, for the meridian of the place of observation.

	h. m. s.
Time by chro., Aug. 12,	12 54 50
Chronometer *slow*	+ 10 48
Mean time at Greenwich, on Aug. 12,	13 5 38
Venus' hor. par. Aug. 12, from page 307, N. A...	″ 8.0

		° ′ ″
Venus' observed alt.		26 28 30
Index error		− 2 10
	′ ″	26 26 20
Dip of hor.	− 4 42	− 6 37
Refraction	− 1 55	
		26 19 43
Par. in alt. (XLVIII)		+ 7
Venus' true altitude		26 19 50

	h. m. s.
Sun's R.A., Aug. 12,	9 27 40
Hr.diff. +9s.45 × 13h. =	+ 2 3
Sun's R.A. Green. time	9 29 43
	m. s.
Eq. of time, Aug. 12,	4 48.79
Hr.diff. + 0s.41 × 13h. =	− 5.33
Eq. at Greenwich time	4 43.46

	h. m. s.		
Venus' R.A., Aug. 12..	12 2 10	(p.262, N.A.)	
Venus' R.A., Aug. 13..	12 6 16		
Variation in 24 hours..	4 6	Log.	0.7674
Greenwich mean time..	13h. 6m.	Log.	0.2629
	h. m. s.		
*Variation in 13h. 6m..	+ 2 14	Log.	1.0303†
Venus' R. A., Aug. 12,	12 2 10		
Ditto at Green. time ..	12 4 24		

	° ′ ″		
Venus' dec. Aug. 12 ..	0 9 22 N.		
Venus' dec. Aug. 13 ..	0 21 26 S.		
Variation in 24 hours..	2) 30 48		
	15 24	Log.	.1927
Green. mean time	13h. 6m.	Log.	.2629
	′ ″ 8 24	Log.	.4556
	× 2		
Variation in 13h. 6m..	− 16 48		
Venus' dec. Aug. 12 ..	0 9 22 N.		
Ditto at Green. time ..	0 7 26 S.		
	90		
Venus' polar distance	90 7 26		

	° ′		
Venus' polar distance	90 7½	..........Co-secant	0.00000
Ship's latitude	27 28	..........Secant ..	0.05194
Venus' true altitude..............	26 20		
Sum..........................	143 55½		
Half-sum	71 58	..........Co-sine..	9.49076
Remainder	45 38	..........Sine	9.85423
	h. m. s.		
Venus' distance from the meridian	3 59 42 W.	........Log.	9.39693 (XXXI.)
Venus' right ascen. at Greenw. time ..	12 4 24		
Right ascension of the meridian	16 4 6		
Sun's right ascension at Greenwich time	9 29 43		
Apparent time at ship................	6 34 23		
Equation at Greenwich time	+ 4 43		
Mean time at ship	6 39 6		
Mean time by the chronometer........	12 54 50		
Chronometer *fast* for mean time	6 15 44		

	h. m. s.
....	6 34 23
Mean time by the chronometer ..	12 54 50
Chronometer *fast* of app. time	6 20 27

To find the apparent and mean Time at Ship, or Place of Observation, and thence the Error of the Watch or Chronometer, by an altitude of the Moon.

RULES. 1. With the estimated longitude and apparent time at ship, or by a chronometer, find the mean time at Greenwich by the Rules in Page 230.

2. From the observed altitude of the moon's upper or lower limb, compute the true altitude of the moon's centre by the Rules in Pages 186, 187.

3. From Page II. of the month in the Nautical Almanac, take out the sun's right ascension, and reduce it to Greenwich mean time (XXII. or XXXIII.), or by the hourly difference, as given in the Naut. Alm.

NOTE. *Or Venus' right ascension and declination may be more readily obtained, thus*:—

* Hrly. var. of Venus' rt. ascen. (Aug. 12, p. 309 N.A.) is 10s.29 × 13h. = 133s.77 = 2m.14s. for R. ascen.

† Hourly var. of Venus' declin. (Aug. 12, p. 309 N.A.) is 77″.0 × 13h. = 1001″.0 = 16′41″ for declin.

4. From Pages V. to XII. of the Nautical Almanac, take out the moon's right ascension and declination, for the given day and hour at Greenwich, and reduce them to Greenwich mean time (XLVII)

5. Take the equation of time from Page I. of the Nautical Almanac, and reduce it to Greenwich mean time by the hourly difference.

6. Proceed as with the sun, by either of the methods given in Pages 230, 231, to find the moon's meridian distance, and thence compute the apparent and mean time at ship, as directed by the Rules for a Star, in Page 234.

EXAMPLE I.

April 27, 1866, in latitude 30° 37′ S., and longitude by account 169° 45′, E., at 7h. 49m. 13s. P.M. apparent time by watch; suppose the observed altitude of the Moon's *lower limb* to be 45° 57′ 30″ (*Eastward of the meridian*), the instrument being adjusted, and the height of the observer's eye 16 feet: required the apparent and mean time at the ship, and the error of the watch at the place of observation.

	h.	m.	s.
App. time at ship on April 27 ..	7 24	49	13
	31	49	13
Long. 169°45′ in time	11	19	0 E.
App. time at Greenwich, April 26..	20	30	13
Equation of time ..	−	2	26
Mean time at Gr. April 26	20	27	47

	°	′	″
Obs. alt. Moon's L.L.	45	57	30
Dip of Horizon....	−	3	50
	45	53	40
☽'s sem. + 14′ 50″ Augment. + 11″	+	15	01
Moon's app. alt....	46	08	41
Moon's corr. (XXX.)	+	36	46
Moon's true alt....	46	45	27

	m.	s.
Eq. of time, April 26, ..	2	17.08
Hour. diff. +0s.43 × 20½h. =	+	8.81
Eq. at Greenwich time ..	2	25.89

In page III of April, in the N.A., the moon's semidiameter on the 12th, at 20h. 21m. is 16′ 22″, and her horizontal parallax 60′ 00″.

	h.	m.	s.		
☽'s R.A. April 26, at 20h.	12	32	29	(p. VII. N.A.)	
☽'s R.A. April 26, at 21h.	12	34	23		
Variation in 1 hour....		1	54	Log.	1.4994
Green. time after 20 hrs.		27m.	47s.	Log.	0.3344
	h.	m.	s.		
Variation in 27m. 47s..	+	0	53	Log.	1.8338
☽'s R.A. April 26, at 20h.	12	32	29		
☽'s R. A. at Green. time	12	33	22		

	°	′	″		
☽'s dec. April 26, at 20h.	3	47	30 S.	(p. VII. N.A.)	
☽'s dec. April 26, at 21h.	3	56	45 S.		
Variation en 1 hour..		09	15	Log..	0.8120
Green. time after 20 hrs.		27m.	47s.	Log..	0.3344
	°	′	″		
Variation in 27m. 47s.	+	4	17	Log..	1.1464
☽'s dec. April 26, at 20h.	3	47	30 S.		
☽'s dec. at Green. time	3 90	51	47 S.		
Moon's polar distance	86	08	13		

	h.	m.	s.
Sun's R. A., April 26..	2	14	45
Hr. diff. +9s.43 × 20½h. =	+	3	13
Sun's R. A. at Gr. time	2	17	58

	°	′		
Moon's polar distance	86	8	.... Co-secant	0.00099
Ship's latitude	30	37	.... Secant ..	0.06520
Moon's true altitude	46	45		
Sum	163	30		
Half-sum	81	45	.... Co-sine..	9.15683
Remainder..........	35	00	.... Sine	9.75859

	h.	m.	s.		
Moon's meridian distance............	2	24	17 E.	.... Log.....	8.98161 (XXXI.)
Moon's right ascen. at Green. time....	12	33	22		
Right ascension of meridian	10	9	5		
Sun's right ascen. at Greenwich time ..	2	17	58		
Apparent time at ship	7	51	7		
Equation at Greenwich time	−	2	26		
Mean time at ship	7	48	41		
Time by the watch	7	49	13		
Watch *fast* for mean time		0	32		

	h.	m.	s.
Apparent time at ship	7	51	7
Time by the watch	7	49	13
Watch *slow* for apparent time		1	54

EXAMPLE II.

Oct. 24th, 1866, A.M., at Ship, in latitude 28°45′ N., when a chronometer, which was 6m. 38s. *fast* for Greenwich mean time, shewed 16h. 42m. 28s., suppose the altitude of the Moon's *lower limb* to be 20° 37′ 45″ (*Westward of the meridian*), the error of the sextant being 2′ 20″ to add, and the height of the observer's eye 18 feet: required the apparent and mean time at the ship, also the error of the chronometer at the place of observation.

	h.	m.	s.
Mean time by chronometer, Oct. 23	16	42	28
Chronometer *fast*..	—	6	38
Meantime at Greenwich, on Oct. 23	16	35	50
		m.	s.
Eq. of time, Oct. 23,		15	34.56
H.diff.0s.34×16⅔h.=		+	5.66
Eq. at Green. time..		15	40.22

	°	′	″
Obs.alt.moon's L.L.	20	37	45
Index error	+	2	20
	20	40	5
Dip of the horizon..	—	4	4
′ ″	20	36	1
☽'s semid. + 16 37 Augm.(VII.) + 6	+	16	43
Moon's app. alt...	20	52	44
Moon's corr.(XXX)	+	54	25
Moon's true alt...	21	47	9

	h.	m.	s.
Sun's R. Ascen., Oct. 23.	13	51	7
Hr.dff.+9s.51×16h.36m.=	+	2	38
Sun's R. A. at Green.time	13	53	45

In page III. of October, in the NA., the moon's semidiameter on the 23rd, at 16h.36m. is 16′37″, and her horizontal parallax 60′ 53″. (L.V.)

	h.	m.	s.		
☽'s R.A. Oct. 23, at 16h.	2	5	48	(p. X. N.A.)	
☽'s R.A. Oct. 23, at 17h.	2	8	15		
Variation in 1 hour ..		2	27	..Log.	1.3890
Green. time after 16hrs. 35m. 50s.				..Log.	0.2239
	h.	m.	s.		
Variation in 35m. 50s...	+	1	28	..Log.	1.6129
☽'s R.A. Oct. 23, at 16h.	2	5	48		
☽'s R.A. at Green. time	2	7	16		

	°	′	″		
☽'s dec. Oct. 23, at 16h.	9	57	49N.	(p. X. N.A.)	
☽s' dec. Oct. 23, at 17h.	10	7	44N.		
Variation in 1 hour..		9	55	.. Log.	0.7818
Green. time after 16hrs. 35m. 50s...				Log.	0.2239
	°	′	″		
Variation in 35m.50s.	+	5	55	.. Log.	1.0057
☽'s dec. Oct. 23, at 16h.	9	57	49 N.		
☽'s dec at Green.time	10	3	44 N.		
	90				
Moon's polar distance	79	56	16		

	°	′		
Moon's polar distance	79	56	......Co-secant	0.00674
Ship's latitude	28	45	......Secant ..	0.05714
Moon's true altitude......	21	47		
Sum	130	28		
Half-sum................	65	14	......Co-sine..	9.62214
Remainder	43	27	......Sine	9.83741

	h.	m.	s.	
Moon's distance from the meridian	4	42	19	W. ..Log..... 9.52343 (XXXI.)
Moon's right ascension	2	7	16	
Right ascension of the meridian	6	49	35	
	24			
	30	49	35	
Sun's right ascension	13	53	45	
Apparent time at ship	16	55	50	
Equation at Greenwich time	—	15	40	
Mean time at ship.....................	16	40	10	
Mean time by the chronometer	16	42	28	
Chronometer *fast* for mean time		2	18	

	h.	m.	s.
....	16	55	50
Mean time by the chronometer....	16	42	28
Chronometer *slow* of apparent time	0	13	22

To find the Error of a Watch or Chronometer by equal Altitudes of the Sun.

RULES.—1. In the morning, when the sun is nearly east, or when it is not less than two or three hours distant from the meridian, take several altitudes of the upper or lower limb, and note the corresponding times that are shewn by the watch or chronometer since the preceding noon. In the afternoon observe when the sun's limb has the same altitude, and note down the times opposite the respective altitudes, reckoning the times of the afternoon altitudes from *noon of the same date* as those taken in the morning

2. Add together the means of the times at each set of observations; half their sum will be the middle time between the observations, or approximate time by the watch, when the sun is on the meridian; their difference will be the interval of time.

3. Find the equation of equal altitudes, as directed in the Explanation to Table LII., and apply it to the middle time; the result will be the time shewn by the watch at apparent noon, or when the sun is on the meridian at the given place: the difference between that time and 24 hours will be the *error* of the watch *for apparent time.*

4. To find the error of the watch for mean time, apply the equation of time (taken from Page I of the Nautical Almanac), and reduced to Greenwich time by the hourly difference, which apply, by addition or subtraction, as directed at the head of the column from whence it is taken, and the sum or remainder will be the mean time when it is apparent noon at the place of observation; the difference between which and the time by the watch at apparent noon, will be its *error for mean time.*

NOTE. This method of finding the error of a watch or chronometer, and thereby regulating its going, is well adapted for practice on shore, where the altitudes may be taken with a sextant by means of an artificial horizon,* and the corresponding times found with great exactness; and it is recommended, in observing, to fix the index of the sextant to some particular division, and wait till the contact of the images takes place.

EXAMPLE I.

July 22, 1866, (*civil time*), at Edinburgh, in latitude 55° 58′ N., and longitude 3° 10′ W., the following observations were made at equal altitudes of the sun's lower limb: required the error of the watch for apparent and mean time at Edinburgh.

Alts. Sun's L.L.	Times A.M.	Times P.M.		
°	h. m. s.	h. m. s.		° ′ ″
35 10	20 8 20	27 43 42	Sun's decl. July 21, (p. II. N.A.)	20 29 18 N.
35 20	9 29	42 35	Ditto, July 23	20 5 26 N.
35 30	10 37	41 24		
			Change in two days	23 52
	3) 28 26	127 41		= 1432″
Means	20 9 29	27 42 34	Sun's decl. July 22, (p. II. N.A.)	20° 17½ N.
	27 42 34	20 9 29		90
Interval	7 33 5	2) 47 52 3	Sun's polar distance	69 42½
	Middle time...	23 56 1·5		

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* For a description of the several kinds of artificial horizons, and the method of taking altitudes with them, see page 223.

Interval	7h. 33m.	Log. A. 7. 7978	....	Log. B.	7. 5383
Chr. in 2 days	1432″	Log... 3. 1559	....		3. 1559
Latitude	55° 58′	Tang. 0. 1705	Polar dist. 69° 42′½	Co-tan....	9. 5679
First part	+ 13s. 31	Log... 1. 1242	Second part − 1s. 83	Log ...	0. 2621
Second part	− 1 . 83				
	+ 11 . 48	Equation of equal altitudes.			

	h. m. s.		m. s.
Time at Edinburgh, July 22 ...	0 0 0	Eq. of time, (p. I. N.A.) July 22 +	6 7. 96
Longitude 3° 10′ in time	+ 12 40W.	Hourly diff. 0s. 10 × 0h. 13m. = +	0. 02
Time at Greenwich	0 12 40	Equation at Greenwich time... +	6 7. 98

	h. m. s.		h. m. s.
Middle time by watch	23 56 1.5		
Equation of equal altitudes	+ 11.5		
Time by watch at apparent noon	23 56 13	....	23 56 13
	24		
Watch *slow* for apparent time ...	3 47		
		Mean time at apparent noon = 24h. + Equation of time 6m. 8s. =	24 6 8
		Watch *slow* for mean time at Edinburgh	9 55

EXAMPLE II.

April 10, 1866, (*civil time*), at Bombay, in latitude 18° 56′ N., and longitude 72° 54′ E., the following equal altitudes of the sun's lower limb were observed, with the corresponding times by a chronometer: required the error of the chronometer for apparent and mean time at Bombay.

Alts. Sun's L. L. ° ′	Times by Chro. A.M. h. m. s.	Times by Chro. P.M. h. m. s.		° ′ ″
29 0.........	15 1 54.........	23 18 12	Sun's decl., April 9, (p. II. N.A.) ...	7 35 53 N.
29 5.........	2 16.........	17 49	Ditto April 11	8 20 13 N.
29 15.........	3 3.........	17 1		
29 20.........	3 24.........	16 41	Change in two days	44 20
			=	2660″
	4) 10 37	69 43		° ′
Means	15 2 39	23 17 26	Sun's decl., April 10, (p. II. N.A)	7 58 N.
	23 17 26	15 2 39		90
Interval......	8 14 47	2) 38 20 5	Sun's polar distance	82 2
	Middle time ...	19 10 2. 5		

Interval	8h. 15m.	Log. A. 7. 8126	....	Log. B.	7. 4860
Chr. in 2 days	2660″	Log... 3. 4249	....		3. 4249
Latitude	18° 56′	Tang.. 9. 5353	Polar dist. 82° 2′	Co-tan.	9. 1460
First part...	− 5s. 93	Log.... 0 7728	Second part + 1s. 14	Log. ...	0. 0569
Second part	+ 1 . 14				
	− 4 . 79	Equation of equal altitudes.			

	h. m. s.		m. s.
Time at Bombay, April 9………	24 0 0	Eq. of time (p. I. N. A.) April 9,	+ 1 36.77
Longitude 72° 54′ in time……..	4 51 36 E.	Hourly diff. 6s.70 × 19h. 8m. =	− 13.40
Time at Greenwich …………….	19 8 24	Equation at Greenwich time…	+ 1 23.37
	h. m. s.		
Middle time by chronometer……	19 10 2.5		
Equation of equal altitudes ……	− 4.8		h. m. s
Time by chronometer at app. noon	19 9 57.7	…………………………………	19 9 57.7
	24		
Chro. *slow* for app. time at Bombay	4 50 2.3		

Mean time at apparent noon = 24h. + Equation of time 1m. 23s. = 24 1 23.4

Chronometer *slow* for mean time at Bombay……………………………… 4 51 25.7

EXAMPLE FOR EXERCISE.

February 23, 1866, (*civil time*), at Funchal, in latitude 32° 37′ 42″ N., and longitude 16° 55′ 30″ W., the mean of several times taken in the morning, shewn by a chronometer, was 9h. 24m. 8s., and the mean of the times corresponding to the same altitudes of the sun's lower limb, taken in the afternoon, was 5h. 13m. 40s.: required the error of the chronometer for apparent and mean time, at the meridian of Funchal.

Answer. The chronometer is 1h. 18m. 42s. fast for *apparent time*, and 1h. 5m. 6s. fast for *mean time*, at Funchal.

ON FINDING THE LONGITUDE BY CHRONOMETERS.

It has already been observed, that if a chronometer could be made to shew always precisely the mean time at Greenwich, or any other given meridian, the longitude of a place, from that meridian, might be easily computed, by comparing the time shewn by the chronometer with that at the given place; but it is hardly to be expected that such a complicated machine can perform so accurately, as never to deviate from the time at the meridian to which it is set: nor indeed is this absolutely necessary; for if its error at the given meridian be known on a certain day, and also its rate (which is its daily gain or loss in 24 hours of mean time), we can thence deduce the time at that meridian as well as if the hands of the chronometer actually pointed it out, provided that it go uniformly, which is all that is essential in the motion of a chronometer. In order, therefore, to obtain these particulars, it is usual for the maker, or person to whose care the machine is entrusted, to examine its error every day, by comparing it with a well-regulated astronomical clock; these errors being then set down in a book kept by him for the purpose, the daily differences shew its rate, and the regularity of its motion

If the errors or daily differences continue the same, the chronometer is said to have no rate, and is keeping mean time exactly. Should the chronometer be too fast, and the error increasing, it is gaining on mean time; but if the error be decreasing, it is then losing: on the contrary, when the chronometer is too slow, and the error increasing, it is losing on mean time; but if the error be decreasing, it is gaining. The rate and error of a chronometer may likewise be ascertained by altitudes of the sun, as will be shewn hereafter. For instance, suppose on a certain day a chronometer was found, by altitudes of the sun, to be 5h. 30m. 10s. too fast for mean time, at the meridian of Madras; and that by observations, taken ten days afterwards, it was 5h. 30m. 40s. too fast, at the same meridian; I thence find that it has gained 30 seconds in 10 days, and conclude that its daily gain is 3 seconds. Again, suppose on August 13th, a chronometer was 12m. 10s. too fast for mean time at Greenwich; but by observations, taken on August 28th, it was found to be 10m. 40s. too fast for mean time at the same place; here it appears that the chronometer has lost 1m. 30s or 90 seconds in 15 days, and consequently is losing 6 seconds daily. Observations of this kind should be repeated and compared together as often as convenient, in order to find the rate the chronometer has gone at between every two such observations, by which the regularity of its going will be proved. Having by these means established its rate and error at the meridian of the place of observation, the longitude of a ship on her voyage may be found by the following

Rules.—1. Take several altitudes of the sun, or other celestial object, when it bears as nearly east or west as possible, but always at least three hours distant from the meridian, and note the times by a chronometer when they are observed, of which take the means.

2. To the mean of the times apply the *original error*, that is, add what the chronometer was too slow, or subtract what it was too fast, for mean time on a given day, at the meridian of the place where the rate was ascertained: the sum or remainder will be the mean time by chronometer, corrected for the original error.

3. Multiply the *daily rate* by the number of days and parts of a day that have elapsed since the original error was determined; the product, which may be called the *accumulated rate*, being added to the above sum or remainder, if the chronometer be losing, or subtracted from it if gaining, the result will give the mean time at the meridian where the rate and original error were ascertained. Should the meridian not be that of Greenwich, then add the longitude of the place in time, if it be west, or subtract it, if east; and the sum or remainder will be the corresponding mean time at Greenwich by chronometer.*

4. With the latitude of the place of observation, the true altitude of the sun or other celestial object, and the reduced declination, find the mean time at the place of observation, as directed by the Rules in Pages 230. 233, 236, or 238; the difference between which, and the mean time at Greenwich, obtained by the chronometer, will give the longitude; east, if the time at the ship be greater, or west, if it be less, than the time at Greenwich.

EXAMPLE I.

May 1, 1866, suppose a chronometer was *fast* for mean time at Greenwich 1m. 18s., and *gaining* 7s.8 per day.

May 19, 1866, P.M., the following altitudes of the sun's lower limb were observed, with the corresponding times by the above chronometer, the height of the observer's eye 18 feet, and the instrument properly adjusted; the latitude at apparent noon being 41°30 N., since which, the ship has run N. W. by N. (*true*) 28 miles, the sun bearing S.W. by W.: required the true longitude of the ship and the variation of the compass.*

	Times by Chro.		Obs. alt. Sun's L.L.		
	h. m. s.		° ′ ″		s.
	6 58 40	....	44 7 10	Daily gain	7.8
	6 59 36	....	43 57 20	Days from May 1 to May 19	18
	7 0 51	....	43 44 35		
Sum of times ...3)	20 59 7	Sum of altitudes ...... 3)	131 49 5		624
					78
Mean of the times	6 59 42	Mean of the altitudes ...	43 56 22		
Original error	− 1 18	Corr. Table IX. +10′.7 =	+ 10 42		60) 140 4
	6 58 24	Sun's true altitude	44 7 4	Gain in 18 days	2m. 20s 4
Accumulated rate	− 2 23			Gain in 7 hours	+ 2s.3
Mean time at Greenwich...	6 56 1 May 19.			Accum. rate ...	2m. 22s.7

	m. s.		° ′ ″
Eq. of time (p. I. N.A.)...	3 46 88 May 19.	Sun's dec. (p.II. N.A.)	19 46 45 N. May 19.
Hour. diff. −0s. 11 × 7h. =	− 0. 77	Hr.diff. +32″.13 × 7h. =	+ 3 45
Equation at Green. time...	3 46.11 May 19.	Sun's dec. at Green. time	19 50 30 N.
			90
Latitude of ship at noon ...	41° 30′ N.		
Diff. of lat. (N W b. N 28m.) =	+ 23 N.	Sun's polar distance ...	70 9 30
Lat. when sights were taken	41 53 N.		

Sun's true altitude ...	44 7	....		Secant ...	0.14392
Polar distance	70 9½	......Co-secant	0.02658		
Ship's latitude	41 53	......Secant ..	0.12813...	Secant ...	0.12813
Sum	156 9½				
Half-sum	78 5	......Co-sine	9.31490...	Co-sine ...	9.31490
Remainder for time ...	33 58	......Sine......	9.74719		
Remainder for azimuth	7 55½	....		Co-sine ...	9 99583
	h m. s.				
Apparent time at ship	3 11 34	...Log.......	9.21680	2)	19.58278
Equation of time	− 3 46				
Mean time at ship ...	3 7 48 May 19.				
Mean time at Green...	6 56 1 May 19.				
Longitude in time ...	3 48 13 = 57° 3′ 15″ W.				

		° ′
	9.79139...Sine	38 13
	×	2
True azimuth...	S.	76 26 W.
Mag. azimuth	S.	56 15 W.
Variation		20 11 East.

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* To find the variation of the Compass by an azimuth; *Vide* Rules in pages 212 and 213.

EXAMPLE II.

June 2, 1866, a chronometer was *slow* for mean time at Greenwich by 3m. 48s., and *gaining* 2s. 4 per day.

June 26, 1866, A. M., *civil time*, the following altitudes of the sun's lower limb were observed, with the corresponding times by the same chronometer, when the sun's bearing was N. 80° 30′ E., the height of the observer's eye being 24 feet, and the error of the sextant 1′ 10″ to add; the latitude at apparent noon 10° 44′ S., and the ship's *true* course E. S. E. 24 miles since the sights were taken: required the true longitude of the ship, and the variation of the compass.*

	Times by Chro.				Obs. alt. Sun's L. L.				
h. m. s.	h.	m.	s.		°	′	″		s.
8. 28 35 A.M. 26th =	20	28	35		13	7	20	Daily gain............	2. 4
		29	20			19	35	Days from June 2 to June 25......	23
		30	18			32	10		
Sum of times......3)		88	13	Sum of altitudes...3)		59	5		72
									48
Mean of the times,	20	29	24	Mean of the altitudes	13	19	42		
Original error	+	3	48	Index error	+	1	10	Gain in 23 days ...	55. 2
								Gain in 20h. 33m.	+ 2. 1
	20	33	12		13	20	52		
Accumulated rate...	−	0	57	Corr. Tab. IX + 7′.1 =	+	7	6	Accumulated rate,	57s. 3
Mean time at Green., June 25	20	32	15	Sun's true altitude	13	27	58		

	m.	s.			°	′	″	
Eq. of time (p. I N A.)...	2	14. 83	June 25	Sun's dec. (p. II. N. A.)	23	24	15	N. June 25
Hour.diff. + 0s.53 × 20½h =	+	10. 86		Hr.diff. − 3″.93 × 20½h =	−	1	21	
Equation at Green. time	2	25. 69	June 25	Sun's dec. at Green. time	23	22	54	N.
					90			
Latitude of ship at noon ...	10°	44′	S.					
Diff. of lat. (E.S.E. 24m) =	−	9	S.	Sun's polar distance ...	113	22	54	
Lat. when sights were taken	10	35	S.					

	°	′					
Sun's true altitude ...	13	28				Secant ...	0.01211
Polar distance	113	23		Co-secant	0.03722		
Ship's latitude	10	35		Secant ...	0.00745	Secant ...	0.00745
Sum	137	26					
Half-sum	68	43		Co-sine...	9.55988	Co-sine...	9.55988
Remainder for time ...	55	15		Sine	9.91469		
Remainder for azimuth	44	40				Co-sine..	9.85200
	h.	m.	s.				
Time from noon	4	40	46	Log.......	9.51924	2)	19.43144

	h.	m.	s.	
	24			
Apparent time at ship..	19	19	14	
Equation of time	+	2	25	
Mean time at ship ...	19	21	39	June 25.
Mean time at Green...	20	32	15	June 25.
Longitude in time ...	1	10	36	= 17° 39′ 00″ W.

		°	′	
9.71572...	Sine	31	19	
		×	2	
True azimuth...	N.	62	38	E.
Mag. azimuth...	N.	80	30	E.
Variation		17	52	W.

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* To find the variation of the Compass by an Azimuth; *Vide* Rules in pages 212 and 213.

EXAMPLE III.

September 15, 1866, suppose a chronometer was *slow* of Greenwich mean time 5m. 26s., and losing 12s. 5 per day.

October 18, 1866, P. M., at ship, in latitude 15° 46′ N., suppose the following sights, and corresponding times taken by the same chronometer, (shewing A. M. at Greenwich,) the index error of the instrument + 2′ 20″, and the height of the observer's eye 16 feet: required the true longitude of the ship.

h. m. s.	Times by Chro. h. m. s.		Obs. alt. sun's L. L. ° ′ ″		s.
11 10 55 A.M. 18th=	23 10 55	....	12 50 45	Daily loss	12. 5
	12 15	....	40 10	Days elapsed from Sept. 15 to Oct. 17	× 32
	13 30	....	29 40		
Sum..................3)	36 40	Sum ....3)	120 35		250
					375
Mean of the Times	23 12 13	Mean of the altitudes	12 40 12		
Original error	+ 5 26	Index error............	+ 2 20		60) 400 0
	23 17 39		12 42 32	Loss in 32 days...	6m 40s. 0
Accumulated rate..	+ 6 52	Cor. Table IX. +8′.1=	+ 8 6	Loss in 23h. 18m	+ 12s. 2
Mean time at Green. Oct. 17	23 24 31	Sun's true altitude...	12 50 38	Accumulated rate	6m. 52s. 2

	m. s.	
Equation of time (p. I. N. A.)	14 33. 66	Oct. 17.
Hour. diff. +0s. 50×23⅓h.=	+ 11. 75	
Equation at Greenwich time	14 45. 41	Oct. 17.

	° ′ ″	
Sun's declin (p. II. N. A.)	9 16 41	S. Oct. 17
Hr. diff. +54″94×23⅓h.=	+ 21 31	
Sun's declin. at Green. time	9 38 12	S.
	90	
Sun's polar distance......	99 38 12	

	° ′		
Sun's polar distance	99 38	.........Co-secant	0. 00617
Ship's latitude............	15 46	.........Secant ...	0. 01666
Sun's true altitude..............	12 51		
Sum	128 15		
Half-sum	64 7½	.........Co-sine...	9. 63989
Remainder	51 16½	.........Sine	9. 89218
	h m. s.		
Apparent time at ship	4 54 24	... ..Log.	9. 55490 (XXXI.)
Equation of time...................	− 14 45		
Mean time at ship	4 39 39	October 18.	
	24		
Mean time at Ship	28 39 39	October 17.	
Mean time at Greenwich	23 24 31	October 17.	
Longitude of ship in time	5 15 8	= 78° 50′ 47″ East.	

EXAMPLE IV.

April 2, 1866, suppose a chronometer was 10m. 15s. *fast* for mean time at Greenwich, and *losing* 4. 3s. per day.

April 25, 1866, A. M., (*civil time*), in latitude 27° 19′ S., suppose the following altitudes, with their corresponding times by the same chronometer, the times noted being P.M. at Greenwich; the error of the sextant + 2′ 40″ and height of the observer's eye 30 feet: required the true longitude of the ship.

	Times by Chro. h. m. s.		Obs. alt. sun's L. L. ° ′ ″		s.
	1 50 55	………………………	18 30 45	Daily loss ……………	4. 3
	52 10	………………………	42 10	Days elapsed from April 2 to April 25	23
	53 28	………………………	53 50		
Sum………………3)	156 33	Sum ………………3)	126 45		129
					86
Mean of the Times	1 52 11	Mean of the altitudes	18 42 15		
Original error ……	− 10 15	Index error…………	+ 2 40		60) 98. 9
	1 41 56		18 44 55	Loss in 23 days…	1m 38s. 9
Accumulated rate..	+ 1 39	Cor. Table IX. +8′.0=	+ 8 0	Loss in 1h. 42m…	+ .2
Mean time at Green. Apr. 25	1 43 35	Sun's true altitude…	18 52 55	Accumulated rate	1m. 39s. 1
	24				
Mean time at Green. Apr. 24	25 43 35				

	m. s.		° ′ ″
Equation of time (p. I. N. A.)	2 6. 56 Apr. 25.	Sun's declin. (p. II. N. A.)	13 12 25 N. Apr. 25.
Hour. diff. +0s. 45 × $1\frac{3}{4}$h. =	+ 0. 78	Hr. diff. +48.″81 × $1\frac{3}{4}$h. =	+ 1 25
Equation at Greenwich time	2 7. 34 Apr. 25.	Sun's declin. at Green. time	13 13 50 N.
			90
		Sun's polar distance …	103 13 50

	° ′	
Sun's polar distance …………	103 14	………Co-secant 0. 01169
Ship's latitude………………	27 19	………Secant … 0. 05135
Sun's true altitude……………	18 53	
Sum ………………………………	149 26	
Half-sum ………………………	74 43	………Co-sine… 9. 42093
Remainder ……………………	55 50	………Sine …… 9. 91772
	h m. s.	
Time from noon ………………	4 1 9	……Log. …… 9. 40169 (XXXI.)
	24	
Apparent time at ship ………	19 58 51	
Equation of time………………	− 2 7	
Mean time at Ship ……………	19 56 44 April 24.	
Mean time at Greenwich ……	25 43 35 April 24.	
Longitude in time ……………	5 46 51 = 86° 42′ 45″ West.	

EXAMPLE V.

January 6, 1866, suppose a chronometer was *fast* by 4m. 46s. for mean time at Bombay, in longitude 72° 54′ 24″ E., and *losing* 5.8s. per day.

January 29, 1866, (P. M. at Ship,) in latitude 6° 58′ N., suppose the following altitudes with their corresponding times by the same chronometer (being A. M. *civil time* at Bombay and Greenwich) were taken to ascertain the true longitude of the ship: the error of the sextant 1′ 10″ to add, and the height of the observer's eye 18 feet.

h. m. s.	Times by Chro. h.	m.	s.
11 54 26 A. M. 29th =	23	54	26
		57	17
		59	30
Sum	3)	171	13
Mean of the times	23	57	4
Original error ...	−	4	46
	23	52	18
Accumulated rate	+	2	13
Mean time at Bombay	23	54	31
Long. Bombay in time	4	51	38 E.
Mean time at Greenwich ...	19	2	53 Jan. 28.

Obs. Alt. Sun's L. L.	°	′	″
....	48	41	40
....		30	20
....		19	6
Sum.....................	3)	91	6
Mean of the altitudes	48	30	22
Index error...........	+	1	10
	48	31	32
Corr. Tab. IX + 11′.3 =	+	11	18
Sun's true altitude...	48	42	50

	s.
Daily Loss	5.8
Days elapsed from Jan. 6 to Jan. 28	22
	116
	116
	60) 127.6
Loss in 22 days...	2m. 7s. 6
Loss in 23h. 52m.	+ 5s. 8
Accumulated rate.	2m. 13s. 4

	m.	s.	
Equation of time (p. I. N. A.)	13	15.61	Jan. 28.
Hour. diff. + 0s.46 × 19h. =	+	8.74	
Equation at Green. time...	13	24.35	

	°	′	″	
Sun's declin. (p. II. N. A.)	18	10	21	S. Jan. 28
Hr. diff. − 39″.64″ × 19h. =	−	12	33	
Sun's dec. at Green. time	17	57	48	S.
	90			
Sun's polar distance......	107	57	48	

	°	′		
Sun's polar distance................	107	58	.........Co-secant	0.02171
Ship's latitude	6	58	........Secant ...	0.00322
Sun's true altitude	48	43		
Sum	163	39		
Half-sum	81	49½	.........Co-sine...	9.15289
Remainder	33	6½	.........Sine	9.73737

	h.	m.	s.	
Apparent time at ship.........	2	13	20	.........Log ...... 8.91519 (XXXI.)
Equation of time	+	13	24	
Mean time at ship	2	26	44	January 29.
	24			
Mean time at ship	26	26	44	January 28.
Mean time at Greenwich ...	19	2	53	January 28.
Longitude in time	7	23	51	= 110° 57′ 45″ East.

EXAMPLE VI.

May 5, 1866, at James Town, St. Helena, in longitude 5° 45′ 15″ W., suppose a chronometer was found to be *fast* 54m. 32s. for mean time, and *gaining* daily 15s.4.

And, on May 28, 1866, in latitude 7° 45′ N., suppose the mean of several altitudes of the star Antares α Scorpii *(eastward of the meridian)* to be 30° 41′ 30″, and the mean of the corresponding times by the above chronometer 10h. 13m. 21s. P.M., the height of the observer's eye being 22 feet: required the true longitude of the ship.

	h. m. s.
Time by chron ...	10 13 21
Original error......	— 54 32
	9 18 49
Accum rate	— 6 0
Mean time at St. Helena ...	9 12 49
Long. St. Helena in time (XIX)	+ 23 1W.
Mean time at Green. May 28	9 35 50

	° ′ ″
Star's obs. altitude,	30 41 30
Dip of the horizon..	— 4 30
	30 37 0
Refraction (IV.) ...	— 1 37
Star's true altitude,	30 35 23
	h. m. s.
Sun's R.A., May 28,	4 20 9
Corr. for 9h. 36m. ..	+ 1 37
⊙'s R.A. at Gr. time	4 21 46

	s.
Daily Gain	15.4
Days elapsed from May 5 to May 28,	23
	462
	308
	60) 354.2
Gain in 23 days ..	5m. 54s. 2
Gain in 9h. 19m.	+ 5s. 9
Accumulated rate,	6m. 0s. 1

	h. m. s.
Star's right ascen. Jan. 1860 (XIII.)	16 20 50
Ann. Var. + 3s.66 × 6½ = 23s.79 =	+ 24
Star's right ascension, May, 1862...	16 21 14*

	° ′ ″
Star's dec, Jan. 1860, (XIII.)...	26 7 3 S.
Ann. Var. + 8″.45 × 6½ = 54″.92	+ 55
Star's declination, May, 1862...	26 7 58 S.*
	90
Star's polar distance	116 7 58

	° ′		
Star's polar distance	116 8	.........Co-secant	0.04683
Ship's latitude	7 45	.........Secant ...	0.00399
Star's true altitude	30 35		
Sum	154 28		
Half sum	77 14	.........Co-sine...	9.34436
Remainder..........................	46 39	.........Sine	9.86164
	h. m. s.		
Star's meridian distance	3 21 13 E.	Log	9.25682 (XXXI.)
Star's right ascension	16 21 14		
Right ascension of meridian	13 00 01		
Sun's right ascension	4 21 46		
Apparent time at ship..................	8 38 15		
Equation of time	— 3 0		
Mean time at ship	8 35 15 May 28.		
Mean time at Greenwich...............	9 35 50 May 28.		
Longitude in time	1 0 35 = 15° 8′ 45″ W.		

	m. s.
Equation of time, May 28 ...	3 2.65
Hour diff. — 0s. 30 × 9⅔h. =	— 2.90
Equation at Green. time	2 59.75

Note.—The mean time at the ship or place of observation may be computed by an altitude of a planet of the moon, by the rules in pages 236, 238, which, being compared with the mean time at Greenwich, deduced from a chronometer, will give the longitude as in the preceding Examples.

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* Or,—Star Antares' Right Ascen., by N. A., page 368, May 28, is 16h 21m. 15s.
Star Antares' Declination, by N. A., page 368, May 28, is 26° 7′ 53″ S.

In the last two Examples the errors of the chronometers are given for the places where the rates were ascertained; but as it may be more convenient to have their errors on mean time at Greenwich, these may be obtained by applying the longitude in time to the mean time at the place of observation (subtracting in east longitude, and adding in west): the result will shew the mean time at Greenwich.

Suppose (Example V.) that by an observation taken at Bombay, January 6, 1866, the chronometer shewed at mean noon 14h. 16m. 24s.: required its error on Greenwich mean time.

	h.	m.	s.	
Mean time at Bombay (mean noon)	24	0	0	January 15.
Longitude of Bombay 72° 54′ 24″ E. in time (XIX.)	4	51	38	E.
Corresponding mean time at Greenwich	19	8	22	
Mean time shewn by the chronometer	14	16	24	
Chronometer *slow* for Greenwich mean time	4	51	58	January 15.

Then to find the mean time at Greenwich when the altitudes were taken on January 29th, 1866. we should proceed thus:

	h.	m.	s.	
Mean of times by chronometer	23	57	4	January 28.
Original error for Greenwich mean time (January 15)	4	51	58	
	19	5	6	
Accumulated rate	−	2	13	
Mean time at Greenwich when altitudes were taken	19	2	53	January 28.

In Example VI. suppose May 5, 1866, at St. Helena, the chronometer shewed 0h. 54m. 32s., when it was mean noon at that place: required its error on Greenwich mean time.

	h.	m.	s.	
Mean time at St. Helena (mean noon)	0	0	0	May 5.
Longitude of St. Helena 5° 45 15′ W., in time (XIX.)	+	23	1	W.
Corresponding mean time at Greenwich	0	23	1	
Mean time shewn by the chronometer	0	54	32	
Chronometer *fast* for Greenwich mean time	0	31	31	May 5.

Then to find Greenwich mean time when the observations were made, May 28th, 1866, proceed thus:

	h.	m.	s.	
Mean time by chronometer	10	13	21	May 28.
Original error for Greenwich mean time (May 5.)	−	31	31	
	9	41	50	
Accumulated rate	−	6	0	
Mean time at Greenwich when altitudes were taken	9	35	50	May 28.

When several chronometers are on board, the time shewn by one of them, with a corresponding set of altitudes, will serve to find the longitude by them all; for this purpose the observer is to compare one of the chronometers with each of the others, immediately before the observations, and note their differences; these differences are to be applied to the mean of the times shewn by the above chronometer, when the altitudes are taken, which will give the corresponding times by each chronometer. To these apply their original errors and accumulated rates, and the result will be the several mean times at Greenwich, or other meridian to which the chronometers are set; the differences between which and the mean time at ship, deduced from the altitudes, will give the longitude according to each chronometer.

It is the practice with many persons to use a good pocket-watch, having a hand that points out seconds, instead of noting the times by one of the chronometers. When this plan is adopted, the comparisons are to be made before the observations, as above directed, and the differences applied to the times shewn by the watch when the altitudes are taken.

To ensure accuracy, it may be advisable to compare the watch with the chronometers immediately after the observations are made; and if the differences be not the same, a proportional part of the change of differences should be applied to those shewn before the observation.

EXAMPLE VII.

November 15, 1865, a chronometer, No. 156, was 5m. 13s. slow for mean time at Greenwich, and losing daily 6. 4s.

January 24, 1866, (January 25th A. M. *civil time*), in latitude 26° 52′ S., the following altitudes were observed, with the corresponding times by the above chronometer, which had been previously compared with Nos. 284, 376, and 807; required the longitude by each chronometer; also the longitude brought up to noon; the ship having made 10 miles of longitude west between the time of observation and noon; the height of the eye being 20 feet, and the index error of the sextant 1′ to add.

	Times by Chro. No. 156.		Alts. sun's L. L.		
	h. m. s.		° ′ ″		s.
	16 37 16	....	24 23 15	Daily loss of chron. No. 156,	6. 4
	38 1	....	32 50	Days elapsed since Nov. 15,	70
	38 47	....	39 30		
					60) 448. 0
3)	114 4		95 35		
				Loss in 70 days	7m.28. 0s.
Means............	16 38 1	....	24 31 52	Ditto in 16h. 43m.	+ 4. 6
Original error..	+ 5 13	Index error.........	+ 1 0		
				Accumulated rate	7m.32. 6s.
	16 43 14		24 32 52		
Accum. rate....	+ 7 33	Dip of horizon ...	− 4 17		° ′ ″
				Sun's declin., Jan. 24,	19 11 5S
Mean time at Greenwich...	16 50 47		24 28 35	Diff. in 1h. 36″.26 × 16⅚h.=610″.36=	− 10 10
		⊙'s corr. (XVIII.)	− 1 57		
			24 26 38	Sun's declination at Greenwich time ...	19 0 55S
		Sun's semidiameter	+ 16 17		90
		⊙'s true altitude...	24 42 55	Sun's polar distance.	70 59 5

	°		
Polar distance	70 59	Co.-secant	0.02437
Latitude	26 52	Secant	0.04961
True altitude	24 43		
Sum	122 34		
Half-sum	61 17	Co-sine	9.68167
Remainder	36 34	Sine	9.77507
	h. m. s.		
Time from noon	4 45 4	Log	9 53072 (XXXI.)
	24		m. s.
Apparent time at ship	19 14 56	Equation of time, Jan. 24	12 24.82
Equation of time	+ 12 35	Hour. diff. + 0s. 60 × 17h. =	+ 10.20
Mean time at ship	19 27 31	Equation at Greenwich time	12 35.02
Mean time at Greenwich by Chronometer, No. 156	16 50 47		

		° ′ ″	
Longitude in time by ditto	2 36 44 =	39 11 00	East.
Longitude made to noon		− 10 0	West.
Longitude at noon		39 1 00	East.

	No. 284.			No. 376.			No. 807.		
	h.	m.	s.	h.	m.	s.	h.	m.	s.
Chronometer No. 156	16	12	41	16	13	26	16	14	35
Chronometers	16	16	18	16	23	42	16	8	53
Differences	+	3	37	+	10	16	−	5	42
Chronometer, No. 156, when the altitudes were taken	16	38	1	16	38	1	16	38	1
	16	41	38	16	48	17	16	32	19
Original errors	+	7	10	+	10	12	+	15	34
	16	48	48	16	58	29	16	47	53
Accumulated rates	+	2	11	−	7	28	+	3	2
Mean time at Greenwich by the Chronometers	16	50	59	16	51	1	16	50	55
Mean time at ship by the altitudes	19	27	31	19	27	31	19	27	31
Longitude in time	2	36	32	2	36	30	2	36	36
	°	′	″	°	′	″	°	′	″
Longitude of ship	39	8	00	39	7	30	39	9	00 E.
Longitude made to noon	−	10	0	−	10	0	−	10	0 W.
Longitude at noon	38	58	00	38	57	30	38	59	00 E.

Longitude by No. 156	39 1 00	E.
" " No. 284	38 58 00	
" " No. 376	38 57 30	
" " No. 807	38 59 00	
	4) 155 55 30	
Mean Longitude at noon	38 58 52	E.

To find the Rate of a Chronometer or Timekeeper.

When a chronometer is received from the maker, or person to whose care it has been entrusted to regulate its going, a memorandum is always given with it, stating how much it is fast or slow for mean time at the meridian of Greenwich, or any other given place, on a given day; and its daily rate of going, that is, its gain or loss in 24 hours mean time, in seconds and tenths of a second: these particulars should be entered in a book kept for the purpose of carrying on the sum of the daily rates, or the total gain or loss of the chronometer, to each day at noon; so that the accumulated rate may be readily known, without the trouble of calculating its amount every day of observation.*

Should the rate of a chronometer continue always uniform, the longitude is to be found as shewn in the preceding pages; but as these instruments are liable to vary their rates, it is necessary to examine their going whenever opportunities present themselves: and this may easily be done when the ship is in harbour, or in the same place two or three weeks, by taking a set of altitudes when the sun is at a proper distance from the meridian, from which the mean time at the place of observation may be obtained; the difference between which, and the mean of the times pointed out by the chronometer, will give what it is fast or slow at that meridian.

Immediately before the ship sails, repeat these observations, and find again how much the chronometer is fast or slow for mean time; the difference of these errors, when they are both of the same name, or their sum, when of contrary names, will be the whole gain or loss during the interval between the two observations: therefore to find the daily rate, say, as the interval of time is to 24 hours, so is the whole gain or loss, to the daily rate

If the chronometer be fast at the time of the first observation, and the error be increasing, it is evidently gaining on mean time; but if decreasing, it is losing: on the contrary, if it be too slow at the time of the first observation, and the error increasing, it is losing; but if the error be decreasing, it is gaining.

The rate deduced from the comparison of the errors, is founded on the supposition, that the motion of the chronometer is uniform during the interval of time between the observations; but should that not be the case these observations will not detect its irregularity: it will therefore be prudent to take the observations as frequently as circumstances will permit, by which several rates will be found, differing perhaps a little from each other; but the means of these may be considered as the true rate, and employed as such in subsequent observations for finding the longitude.

If any of the rates found as above, should differ materially from the rest. such rates should be altogether rejected, as probably arising from some error in the observations, or irregularities in the going of the chronometer.

When several observations are taken, by some of which the chronometer is found to be gaining, and by others losing, take the difference between the sum of all the gainings, and the sum of all the losings, which divide by the number of days elapsed while it was under trial, and the quotient will be the mean rate, of the same denomination with the greater quantity.

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* Books ruled for this purpose may be had at the Publishers' of the present Work.

The method of finding the rate of a chronometer by altitudes taken in the usual way, from the horizon of the sea, is well adapted to the practice of seamen; and if the observations be taken with care and skill, the rate so found, may be sufficiently exact for the usual length of a West India voyage: but it must be observed, that if there be an error in the daily rate, since that error accumulates every day, the longitude deduced from the chronometer at the end of a long interval, may in that case be wide of the truth.

The rate may, however, be found nearly as correct as with an astronomical clock, by equal or single altitudes taken on shore with a sextant and an artificial horizon: indeed, these two instruments may be considered a portable observatory, and a person with their assistance will be enabled to regulate chronometers wherever he may chance to stop a few days. And here we must remark, it is not necessary to take the chronometer on shore for that purpose; for if the observer have a good watch, that shews seconds, it may be compared with the chronometer immediately before he goes on shore; and the difference applied to the mean of the times pointed out by the assistant watch, when the altitudes are taken, will be the time by the chronometer, corresponding to the mean of the altitudes. In fact, the rate should always be ascertained, if possible, when the chronometer is on board ship, where being once fixed, it should on no account be removed;* for it has been found by experience, that the motion of a chronometer is generally accelerated after being received on board, whereby a losing rate will be diminished, and a gaining one increased: this effect has been ascribed to "the magnetic action exerted by the iron in the vessel on the inner rim of the balance, which is made of steel."†

When the motion of a chronometer is accelerated after its rate has been determined, the longitude resulting from observations made with it, will be to the westward of the true longitude; and when its motion is retarded, it will give the longitude too far to the eastward.

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* Chronometers should always be placed a-midships, and as nearly as possible to the ship's centre of motion; but at the same time at a distance from the iron-work of the ship.

Commander R. Owen, R. N., who has had considerable experience as a Navigator, recommends, as the least objectionable method of fixing chronometers, that of having a table hung on gimbols, with a weight of from 20 to 50 lbs. suspended underneath, in the manner of an azimuth compass, so that the centre of gravity be as near the centre of its motion as possible, to permit it to keep its level permanently, without being subject to vibrate, and the axes of the gimbols to work in smooth stuffed leather sockets, bearing against springs in every direction; these springs being neither too stiff, nor too sensible, for the weight they are to support. The pillars, or stand for the sockets, to be a fixture in the deck. The chronometers to be placed in small partitions on the table, and to be wedged securely in their places by soft cushions.

Commander O. also observes, that it is sometimes the practice to keep chronometers (particularly the small case ones) in drawers; but this is very objectionable, on account of the opening and shutting, which is sufficient of itself to derange them.

† See Mr. Fisher's Paper on the Errors in Longitude, as determined by Chronometers at Sea read before the Royal Society, June 8, 1820.—Phil. Trans. 1820, p. 207.

We shall now proceed to illustrate the foregoing rules and remarks by a few Examples.

EXAMPLE I.

October 2, a chronometer was 10m. 42.8s. fast at noon for mean time at Greenwich; and October 11, at noon, it was 11m 19.7s. fast for the same meridian: required the daily rate of the chronometer.

		m.	s.	
October 2	Chronometer was fast......	10	42.8	
October 11	– – fast......	11	19.7	
Interval 9 days.	9)	0	36.9	= gain in 9 days.
	Daily rate...	0	4.1	gaining.

EXAMPLE II.

At noon, June 13, a chronometer was 3m. 37s. fast for mean time at Greenwich; and at noon, June 25, it was 2m. 13.8s. fast for the same meridian: required the daily rate of the chronometer.

		m.	s.	
June 13	Chronometer was fast......	3	37.0	
June 25	– – fast......	2	13.8	
Interval 12 days.	12)	1	23.2	= *loss* in 12 days.
	Daily rate...	0	6.9	losing.

EXAMPLE III.

February 2, at noon, a chronometer was 1m. 10s. fast, and February 23 at noon, was 0m. 50s slow, for Greenwich mean time: required the daily rate of the chronometer.

		m.	s.	
February 2	Chronometer was fast	1	10	
February 23	– – slow......	0	50	
Interval 21 days		2	0	= loss in 21 days.
		60		
	21)	120		
	Daily rate...	5.7s.		losing.

EXAMPLE IV.

November 5, by an observation taken at 4h. 20m. P. M., a chronometer was found to be 2h 10m. 45s slow; and on November 17, at 7h. 32m.

A. M. (*civil time*), it was 2h. 13m 36s slow, at the same meridian: required the daily rate of the chronometer.

November	5 at 4h. 20m.	Chronometer was slow	2h. 10m. 45s.	
November	16 at 19 32	„ „ slow	2 13 36	
Interval...	11 days 15h. 12m.	Loss during the interval ...	0h. 2m. 51s.	

Then, As 11 days 15h. : 24 hours : : 2m 51s. : 14.7s.

Hence the daily rate of the chronometer is 14.7s losing.

EXAMPLE V.

May 1, 1866, at Falmouth, in latitude 50° 9′ N., and longitude 5° 2′ W., at 18h. 45m. mean time, (being May 2, at 6h. 45m. A. M., *civil time*), the following altitudes were taken with *an artificial horizon*, for the purpose of ascertaining the daily rate of a chronometer which had been previously set to Greenwich mean time: the index error of the sextant being 1′ 35″ to be added.

	Times by Chron.			Double alts		
	h	m.	s.	°	′	″
	19	10	30	37	48	45
		12	40	38	4	30
		14	51	38	20	15
3)		38	1	114	13	30
	19	12	40	38	4	30
Index error				+	1	35
2)				38	6	5
Obs alt. sun's L. L.				19	3	2
Sun's corr. (XVIII)				–	2	35
				19	0	27
Sun's semidiameter.				+	15	54
Sun's true altitude..				19	16	21
				90		
Sun's zenith dist. ...				70	43	39

	m.	s.
Eq. of time, May 1.	3	1.98
Hour. diff. 0s.32 × 19h. = ...	+	6.08
Eq. at Green. time..	3	8.06

		h.	m.		
Mean time at Falmouth......		18	45	May 1.	
Longitude in time (XIX.)...		+	20	W.	
Mean time at Greenwich ...		19	5	Log.	0.0996 (XXXIII.)
Variation of dec. in 24 hours		18′	0″	Log.	0.1249
	°	′	″		
Variation in 19h. 5m. ...	+	14	19	Log.	0.2245
☉'s dec. at noon, May 1.	15	5	29	N. (p. II. N. A.)	
					28
Ditto at Greenwich time	15	19	48	N. ......Secant	0.015706
Latitude	50	9	0	N. ......Secant	0.193291
Difference	34	49	12		
Zenith distance	70	43	39		
Sum	105	32	51		40
Half-sum	52	46	25	.........Sine ...	9.901010
Difference	35	54	27		85
Half-difference	17	57	13	.........Sine ...	9.488814
	h.	m.	s.		
App. time from noon ...	5	12	31.5	......Log. ...	9.59897.4 (XXXI.)
	24				
App. time at Falmouth..	18	47	28.5		
Equation of time	–	3	8.1		
Mean time at Falmouth.	18	44	20.4		
Ditto by chronometer ...	19	12	40.0		
Chronometer *fast* for meridian of Falmouth		28	19.6	May 1.	

EXAMPLE VI.

May 2, 1866, at Falmouth, in latitude 50° 9′ N., and longitude 5° 2′ W., at 18h. 50m. mean time, (being May 3, at 6h. 50m. A. M., *civil time*), the following observations were taken with the same instruments as before, to find the daily rate of the chronometer.

	Times by Chron.	Double alts.
	h. m. s.	° ′ ″
	19 17 5	40 10 30
	18 18	23 15
	19 31	37 0
	3) 54 54	70 45
	19 18 18	40 23 35
Index error		+ 1 35
		2) 40 25 10
Obs. alt. sun's L. L..		20 12 35
Sun's corr. (XVIII)		− 2 26
		20 10 9
Sun's semidiameter.		+ 15 54
Sun's true altitude..		20 26 3
		90
Sun's zenith dist. ...		69 33 57
		m. s.
Eq. of time, May 2.		3 9.38
Hour diff. + 0s. 30. × 19h. = ...		+ 5.70
Eq. at Green. time..		3 15.08

	h. m.		
Mean time at Falmouth......	18 50	May 2.	
Longitude in time (XIX.)...	+ 20	W.	
Mean time at Greenwich ...	19 10	Log.	0.0977 (XXXIII.)
Variation of dec. in 24 hours	17′ 45″	Log.	0.1310
	° ′ ″		
Variation in 19h. 10m...	+ 14 10	Log.	0.2287
☉'s dec. at noon, May 2.	15 23 30	N. (p. II. N. A.)	
			23
Ditto at Greenwich time	15 37 40	N. ....Secant	0.016336
Latitude	50 9 0	N. ....Secant	0.193291
Difference....................	34 31 20		
Zenith distance............	69 33 57		
Sum	104 5 17		62
Half-sum	52 2 38	.........Sine ...	9.896729
Difference....................	35 2 37		120
Half-difference............	17 31 18	.........Sine ...	9.478542
	h. m. s.		
App. time from noon ...	5 6 40	.........Log. ...	9.585103
	24		(XXXI.)
App. time at Falmouth..	18 53 20		
Equation of time	− 3 15.1		
Mean time at Falmouth.	18 50 4.9		
Ditto by chronometer ...	19 18 18.0		
Chronometer *fast* for meridian of Falmouth	28 13.1	May 2.	
Ditto ditto	28 19.6	May 1.	
Daily rate of chronometer	6.5	*losing.*	

EXAMPLE VII.

May 5, 1866, at Falmouth, in latitude 50° 9′ N., and longitude 5° 2′ W., at 18h. 45m. mean time (being May 6, at 6h. 45m. A. M., *civil time*,) the following altitudes, with their corresponding times, were taken with the same instruments as before, to find the daily rate of the chronometer.

	Times by Chron. h.	m.	s.	Double alts. °	′	″
	19	5	59	38	4	0
		7	12		19	28
		8	22		34	44
	3)	21	33		58	12
	19	7	11	38	19	24
Index error				+	1	35
				2) 38	20	59
Obs. alt sun's L. L..				19	10	29
Sun's corr. (XVIII)				–	2	35
				19	7	54
Sun's semidiameter.				+	15	53
Sun's true altitude..				19	23	47
				90		
Sun's zenith dist. ...				70	36	13

	m.	s.
Eq. of time, May 5.	3	28.22
Hour diff. + 0s. 23. × 19h. = ...	+	4.37
Eq. at Green. time..	3	32.58

	h.	m.			
Mean time at Falmouth......	18	45		May 5.	
Longitude in time (XIX.)...	+	20		W.	
Mean time at Greenwich ...	19	5		Log.	0.0996 (XXXIII.)
Variation of dec. in 24 hours	16′ 58″			Log.	0.1506
	°	′	″		
Variation in 19h. 5m.	+	13	29	Log.	0.2502
☉'s dec. at noon, May 5.	16	15	58	N. (p. II. N. A.)	
					.17
Ditto at Greenwich time	16	29	27	N.......Secant	0.018226
Latitude	50	9	0	N.......Secant	0.193291
Difference	33	39	33		
Zenith distance............	70	36	13		
Sum	104	15	46		87
Half-sum	52	7	53	.........Sine ...	9.897222
Difference	36	56	40		126
Half-difference............	18	28	20	.........Sine ...	9.500721
	h.	m.	s.		
App. time from noon ...	5	17	9.8	......Log. ...	9.609690 (XXXI.)
	24				
App. time at Falmouth..	18	42	50.2		
Equation of time	–	3	32.6		
Mean time at Falmouth.	18	39	17.6		
Ditto by chronometer ...	19	7	11.0		
Chronometer *fast* for meridian of Falmouth		27	53.4	May 5.	
Ditto ditto		28	13.1	May 2.	
Loss of chro. in 3 days...		0	19.7		
		3)			
Daily rate of chronometer			6.56	*losing.*	

EXAMPLE VIII.

May 7, 1866, at Falmouth, in latitude 50° 9′ N., and longitude 5° 2′ W., at 18h. 35m. mean time, (being May 8, at 6h. 35m A. M., *civil time*,) the altitude of the sun's lower limb, taken as before, and corrected for index error, being 18° 30′ 37″, when the chronometer shewed 19h. 0m. 4s.: to find the daily rate of the chronometer.

Answer.—The mean time at Falmouth 18h. 32m. 24s.7, and the chronometer *fast* 27m. 39s.3, which, compared with its error on May 5, gives its daily rate 7s.0 *losing.*

EXAMPLE IX.

May 11, 1866, at Falmouth, at 18h. 35m. mean time, (being May 12, at 6h. 35m. A. M., *civil time*,) the altitude of the sun's lower limb, taken as before, and corrected for index error, being 19° 2′ 28″, when the chronometer shewed 18h. 57m. 52s.: to find the daily rate of the chronometer.

Answer.—The mean time at Falmouth at 18h. 30m. 41s.1, and the chronometer *fast* 27m. 10s.9, which, compared with its error on May 7, gives its daily rate 7s.1 *losing.*

From the preceding observations, the mean rate may be determined as follows:—

		m.	s.		s.	Daily rates. s.
May 1	Chronometer was fast...	28	19.6			
„ 2	„ „ fast...	28	13.1......	loss in 1 day ...	6.5	=6.5
„ 5	„ „ fast...	27	53.4......	loss in 3 days ...	19.7	÷3=6.6
„ 7	„ „ fast...	27	39.3......	loss in 2 days ...	14.1	÷2=7.0
„ 11	„ „ fast...	27	10.9......	loss in 4 days ...	28.4	÷4=7.1
				Loss in 10 *days...*	68.7	4) 27.2
				Mean daily rate...		6.8

Or 68s.7., the total loss, divided by 10, the number of days elapsed between the first and last observations, gives the mean daily rate 6s.9.

Hence it appears that on May 11, at 18h. 57m. 52s. (May 12, at 6h. 57m. 52s., A.M., *civil time*) the chronometer was *fast* for the meridian of Falmouth, 27m. 10s.9., and *losing* daily 7s.1.

Or if the longitude of Falmouth in time (20m. 8s. W.) be added to 18h. 30m. 41s.1., the mean time at Falmouth when the observation was made May 11, it will give the mean time at Greenwich 18h. 50m. 49s.1., which, subtracted from 18h. 57m. 52s., shews that the chronometer was 7m. 2s.9 *fast* for the meridian of Greenwich.

It is essential that the altitudes used for finding the rate of a chronometer should be observed about the same time of each day, or that the proportional part of the gain or loss should be found; for as the daily rate is the loss or gain in 24 hours, it follows, that if one observation, for instance, be taken in the morning, and another in the afternoon of the following day, the interval being more than a complete day of 24 hours, the difference of the times by the chronometer will be more than the daily rate. Let us suppose that the above series of observations were continued, and that on May 13, altitudes were taken in the afternoon, by which it appeared, the mean time at Falmouth was 5h. 16m. 35s., P.M., when the chronometer shewed 5h. 43m. 35s.5., and was therefore 27m. 0s. *fast* for mean time when the observations were taken.

May 11d.	18h.	30m.	41s.1.	Chronometer was fast	27m.	10s.9
May 13	5	16	35+24h.	„ „	27	00.5
Interval 1	10	45	53.9	Difference...		10.4

The chronometer therefore *lost* 10s.4 in 1 day, 10h. 46m. = 34h. 46m. or 35 hours nearly: consequently, as 35h. : 10s.4. : : 24h. : 7s.1., the daily rate required.

Three or more chronometers may be compared together daily, and a judgment thence formed of the regularity of their going: as for instance, suppose the comparison be made each day about noon with three chronometers: the assumed rate of No. 1 being 2s. gaining; of No. 2, 5s. gaining; and of No. 3, 6s. losing; let the comparisons be made as in the following Tables:

Comparison of No. 2. with No. 1.

Month	Days.	Chro. No. 1.	Chro. No. 2.	First Diff.	Sec. Diff.
		h. m. s.	h. m. s.	m. s.	s.
May	1	0 10 40	0 20 32	9 52	3
	2	0 12 30	0 22 25	9 55	3
	3	0 15 20	0 25 18	9 58	3
	4	0 11 35	0 21 36	10 1	3
	5	0 13 5	0 23 9	10 4	3
	6	0 8 50	0 18 57	10 7	3
	7	0 14 45	0 24 55	10 10	3
	8	0 20 35	0 30 48	10 13	3
	9	0 15 10	0 25 26	10 16	3
	10	0 16 0	0 26 19	10 19	

Daily gain of No. 1....... 2s.
Daily gain of No. 2....... 5

Daily diff. should be...... 3

Comparison of No. 3. with No. 1

Month	Days.	Chro. No. 1.	Chro. No. 3.	First Diff.	Sec. Diff
		h. m. s.	h. m. s.	m. s.	s.
May	1	0 11 10	0 6 45	4 25	8
	2	0 13 0	0 8 27	4 33	7
	3	0 16 10	0 11 30	4 40	6
	4	0 11 55	0 7 9	4 46	8
	5	0 13 50	0 8 56	4 54	7
	6	0 9 15	0 4 14	5 1	9
	7	0 15 20	0 10 10	5 10	8
	8	0 20 50	0 15 32	5 18	6
	9	0 15 55	0 10 31	5 24	9
	10	0 16 40	0 11 7	5 33	

Daily gain of No. 1....... 2s.
Daily loss of No. 3....... 6

Daily diff. should be...... 8

Comparison of No. 3. with No. 2.

Month	Days.	Chro. No. 2.	Chro. No. 3.	First Diff.	Sec. Diff.
		h. m. s.	h. m. s.	m. s.	s.
May	1	0 21 30	0 7 43	13 47	11
	2	0 23 25	0 9 27	13 58	10
	3	0 26 10	0 12 2	14 8	9
	4	0 22 35	0 8 18	14 17	10
	5	0 24 10	0 9 43	14 27	9
	6	0 19 55	0 5 19	14 36	12
	7	0 25 10	0 10 22	14 48	11
	8	0 31 0	0 16 1	14 59	9
	9	0 26 10	0 11 2	15 8	12
	10	0 27 35	0 12 15	15 20	

Daily gain of No. 2......... 5s.
Daily loss of No. 3......... 6

Daily diff. should be 11

Now by comparing No. 2 with No. 1, we find that No. 2 is regularly gaining daily 3s. on No. 1, equal to the difference of their rates; again, No. 3 being compared with No. 1, their daily difference (which should be 8s., the sum of their daily rates, because one is gaining, and the other losing) appears to be irregular; and, lastly, No 3 compared with No. 2, gives also irregular differences, which should be 11s., the sum of their rates: hence we conclude that No. 1 and No. 2 are going steadily, but that No. 3 is going very indifferently.

In winding up a chronometer that is going, great caution should be observed, not to give it circular motion, which would alter its rate some seconds, or, perhaps, even stop its going; but when a chronometer is once suffered to run down, it will not acquire new motion without giving it two or three quick horizontal circular turns; and it must be observed, that when has once stopped, though for ever so short a period, it will not recover the gularity of its motion for some days after, and consequently no reliance can be placed on its performance, until its rate be proved by subsequent observations.

A chronometer should be wound up regularly at the same time of the day, and great care taken not to give the key, first half a turn, then a whole turn, afterwards three-quarters, and so on; for this irregular mode of winding up will sometimes very materially alter its rate, and should be as carefully avoided as circular motion: it is therefore advisable always to to turn the key gently half round at a time, until the spring be wound up The chronometer should also be examined before the case is shut, to ascertain whether it continue going, as sometimes, when wound up in haste, and the chain overstrained, it will be liable to stop.

Chronometers are of great utility in carrying on the longitudes deduced from lunar distances, from one day to another, so that the results of a number of observations may be brought to one point of time. Also, the apparent time found by altitudes taken at a proper distance from the meridian, being carried on by the chronometer, will answer for any lunar observation taken in the course of 24 hours: in fact, whenever it is requisite to measure short intervals of time accurately, or to ascertain the difference of longitude between adjacent places, these instruments are of the greatest importance.

The method of carrying on or deducing the time of taking distances, to the time of taking altitudes for the chronometer, may be illustrated as follows: suppose that altitudes are taken for ascertaining the longitude by chronometers, and that afterwards a set of lunar distances be observed; take the elapsed time, as measured by the chronometer, from observing the time-altitudes to that of observing the distances, and when the time at Greenwich is deduced from the distances, subtract this elapsed time from it, and the remainder will be the time at Greenwich when the altitudes for time were taken, and will produce the longitude at that time, and not when the distances were observed. On the contrary, if a set of lunar distances be taken before the altitudes are observed to find the apparent time, then the elapsed time must be added to the Greenwich time, to bring the longitude to the time when the altitudes were taken.

Or, which is precisely the same thing, ascertain by the altitudes how much the chronometer is too fast or too slow at the meridian of the place of observation: this error being applied to the mean of the times by the same chronometer, when the distances are observed, will reduce the longitude by the lunar observation to the meridian where the error was ascertained; consequently, will give the longitude of the ship when the time-altitudes were observed.

EXAMPLE V.

April 7, 1866, a set of altitudes was taken, which gave the mean time at ship 5h. 13m. 36s., when a chronometer, gaining daily 2s. 5, shewed 2h. 48m. 59s.; and at 11h. 36m. 49s. 1, by the same chronometer, a set of distances was observed, which gave mean time at Greenwich 11h. 22m. 27s.: required the longitude of the ship when the time altitudes were taken for the chronometer (see Example V. on lunar observations page 284.)

	h.	m.	s.	°	′	″	
Mean time by chronometer when the time altitudes were observed	2	48	59				
Mean time by chronometer when the distances were observed......	11	36	49 1				
Interval by chronometer	8	47	50 1				
Mean time at Greenwich when the distances were observed	11	22	27				
Mean time at Greenwich when time alts. were taken for chron....	2	34	36. 9				
Mean time at ship when time altitudes were taken for chronometer	5	13	36. 0				
Longitude when time altitudes were taken for chronometer	2	38	59 1	=39	44	45	E.

(Or thus.)

	h.	m.	s.	°	′	″	
Mean time by chronometer when the time altitudes were observed	2	48	59				
Mean time at ship when time altitudes were taken for chron......	5	13	36				
Chronometer slow at the meridian of the ship	2	24	37				
Mean time by chronometer when the distances were observed ...	11	35	49. 1				
Mean time at the meridian where the altitudes were taken, when the distances were observed	14	1	26. 1				
Mean time at Greenwich when the distances were observed	11	22	27				
Longitude when time altitudes were taken for chronometer	2	38	59. 1	=39	44	45	E.

Observations of lunar distances may be carried on from one time to another, so that when the observer has obtained a number of sets on each side of the moon, he may bring them all to one point of time by the chronometer, and thereby get a mean of all the observations, which will give very nearly the true longitude, if the observations be carefully made. This may be explained as follows:—suppose on January 20th, six sets of lunar distances be observed; on the 21st four more; and on the 23rd, being the last day when the distances are set down in the Nautical Almanac on that side of the moon, six more sets be observed. Bring each set of distances to the time when the altitudes for chronometers were taken on their respective days: then take the difference of longitude shewn by the chronometer between the 20th and the 23rd, at the time the altitudes for the chronometer were observed, which apply to each set taken on the 20th; do the same between the 21st and 23rd; each set will then be brought on to the time when altitudes for the chronometer were taken on the 23rd; in all sixteen sets. The mean of these observations will, in all probability, not be far from the truth. In this manner observations may be carried on, by distances taken on the other side of the moon, and the result deduced from their mean, will approximate still nearer to the truth.

Thus the lunar observations and chronometers may be made to go hand in hand with each other, to discover the ship's true longitude.

EXAMPLES FOR EXERCISE.

1. June 25, 1866, a chronometer was *fast* of Greenwich mean time 2m. 13s. 8, and *losing* 6s 9 daily.

July 8, 1866, P.M. at ship, in latitude 47° 46′ N., suppose the observed altitude of the sun's lower limb to be 26° 32′ 17″, when a chronometer shewed 2h. 50m. 15s. P.M., the height of the observer's eye 28 feet, and index error 4′ 10″ to add: required the longitude of the ship.

Answer. Mean time at ship 5h. 2m. 21s., mean time at Greenwich 2h. 49m. 32s., and the longitude 33° 12′ 15″ East.

2. October 11, 1866, at noon, a chronometer was *fast* for Greenwich mean time 11m. 19s. 4 and was *gaining* 4s. 1 per day.

October 21, 1866, A.M. (*civil time*), in latitude 35° 37′ S., the same chronometer shewed 6h. 42m. 10s. A.M. (*civil time*), at Greenwich, when the observed altitude of the sun's lower limb was 42° 19′ 52″; the index error being 2′ 30″ to subtract, and the height of the eye 20 feet: required the longitude of the ship.

Answer. Mean time at ship, October 20, 20h. 45m. 47s.; mean time at Greenwich 18h. 30m. 11s.; and the longitude 33° 54′ 0″ East.

3. August 7, 1866, at noon, a chronometer was *slow* for mean time at Greenwich 17m. 30s.; and on August 13, at noon, it was *slow* for mean time, at the same meridian, 18m. 45s.

August 23, 1866, A.M. (*civil time*), in latitude 37° 40′ N., when the above chronometer shewed 5h. 53m. 16s. (being P.M. at Greenwich), the observed altitude of the sun's lower limb was 37° 15′ 40″, the index error of the sextant being 2′ 15″ to subtract, and the height of the observer's eye 20 feet: required the longitude of the ship.

Answer. The daily rate of the chronometer was 12s. 5 *losing* the mean time at ship 20h. 37m. 51s.; and the mean time at Greenwich 30h. 14m. 9s. past noon, August 22: and the longitude 144° 4′ 30″ West.

4. January 2, 1866, at noon, a chronometer was 1h. 12m. 52s. 5 *slow* for mean time at Greenwich; and on January 9, at noon, it was 1h. 13m. 57s. *slow* for mean time at the same meridian.

January 30, 1866, P.M., at ship in latitude 30° 20′ N., when the above chronometer shewed 2h. 40m. 15s., (being January 30, A.M., *civil time*, at Greenwich), the observed altitude of the sun's lower limb was 17° 42′ 54″, the index error being 3′ 15″ to add, and the height of the eye 20 feet: required the longitude of the ship.

Answer. The daily rate of the chronometer was 9s. 2 *losing*; the mean time at ship 27h. 57m. 2s.; and the mean time at Greenwich 15h. 57m. 22s. past noon, January 29; the longitude 179° 55′ 00″ East.

5. February 6, 1866, at noon, a chronometer was 27m. 54s. 5 *fast* for mean time at the Cape of Good Hope, in longitude 18° 24′ 24″ E.; and February 13, at noon, it was 29m. 10s. *fast* at the same meridian.

March 3, 1866, about 6h. 15m. P.M., ship time, in latitude 18° 58′ N., the altitude of the star REGULUS was observed to be 17° 42′ 16″ (*East of the meridian*,) when the above chronometer shewed 3h. 10m. 36s. P. M.; the error of the sextant being + 2′ 11″, and the height of the observer's eye 24 feet: required the longitude of the ship.

Answer. The daily rate of the chronometer was 10s. 8 *gaining*; the mean time at ship 6h. 15m. 4s.; the mean time at Greenwich 1h. 24m. 32s. on March 3; and the longitude 72° 38′ 00″ East.

6. September 23, 1866, at noon a chronometer was 10m. 30s. *slow* for mean time at Greenwich, and *losing* daily 12s. 5.

October 11, 1866, in latitude 10° 13′ N., when the above chronometer shewed 9h. 17m. 28s., suppose the observed altitude of the centre of the Planet VENUS to be 27° 42′ 10″ (*West of the meridian*;) the index error of the sextant being + 2′ 44″, and the height of the observer's eye 18 feet: required the longitude of the ship.

Answer. Longitude of the ship, 48° 44′ 37″ West.

7. April 10, 1866, at noon, a chronometer was *slow* for mean time at the Observatory of Paramatta (New South Wales), in longitude 151° 1′ 34″ E., by 9h. 33m. 7s., and *losing* daily 5s. 8.

May 6, 1866, A. M. at ship, in latitude 42° 37′ N., and longitude by account 96° 24′ W., when the above chronometer shewed 1h. 44m. 30s. P.M., suppose the observed altitude of the MOON'S *upper limb* to be 26° 48′ 50″ (*West of the meridian*;) the error of the instrument being − 2′ 30″ and the height of the observer's eye 20 feet: required the true longitude of the ship.

Answer. The longitude of the ship, 96° 25′ 30″ W.

8. September 9, 1866, (*civil time*,) at Bombay, in latitude 18° 56′ N., and longitude 72° 54′ 24″ E., about 7h. 20m. A.M., the double altitude of the sun's lower limb was observed to be 38° 37′ 55″ by *an artificial horizon*, when a chronometer shewed 2h. 31m. 58s. A.M.; and on September 16, about 7h. 24m. A.M., the double altitude of the sun's lower limb was again observed to be 33° 42′, when the same chronometer shewed 2h. 23m. 54s. A.M., the error of the sextant being − 2′ 10″ at both observations: required the rate of the chronometer, and its error on Greenwich mean time, when the latter altitude was taken.

Answer. The chronometer was 11m. 3s. 6 *fast* for Greenwich mean time, September 9, and 12m. 16s. 5 *fast* on September 16; hence the daily rate was 10s. 4 *gaining*.

9. May 4, 1866, at Kingston, (Jamaica,) in latitude 17° 58′ N., and longitude 76° 46′ 10″ W., about 4h. 30m. P.M., the double altitude of the sun's lower limb, taken by *an artificial horizon*, was 49° 34′ 35″, a chronometer, No. 65, shewing at the same time 9h. 30m. 28s. P.M.; and on May 12, about 4h. 36m. P.M., the double altitude of the sun's lower limb was 49° 35′ 50″, when chronometer No. 65 shewed 9h. 31m. 51s. P.M.; the index error of the sextant being + 1′ 15″ at both observations: required the rate of the chronometer, and its error for Greenwich mean time when the latter altitude was taken.

Ans. The chronometer was 6m. 29s. 8 *slow* for mean time at Greenwich on May 4, and 6m. 33s. 5 *slow* on May 12; hence the daily rate was 0s. 46 *losing*.

ON FINDING THE LONGITUDE BY LUNAR OBSERVATIONS.

To find the apparent Altitudes and Distance

Rules.—1. With the apparent time at the ship, and the longitude by account turned into time (XIX)., find the apparent time at Greenwich by the Rules in Page 155; to which apply the equation of time, as directed in Page 153: the result will be the mean time at Greenwich by account. But, should a chronometer be at hand, whose original error and rate are known, the mean time at Greenwich may be more correctly and easily inferred from it, as shewn in the method of finding the longitude by chronometers.

2. From Page III. of the month in the Nautical Almanac, take out the moon's semidiameter and horizontal parallax, and reduce them to the mean time at Greenwich*; and to the semidiameter add the moon's augmentation, taken from Table VII.

3. From the moon's observed altitude† subtract the dip of the horizon (V.), and to the remainder add the moon's augmented semidiameter when the lower limb is observed, or subtract it if the upper limb be taken: the result will be the apparent altitude of the moon's centre.

4. Then, *if the sun be observed*, from the observed altitude of the lower limb subtract the dip of the horizon (V.), and to the remainder add the sun's semidiameter for the given day, taken from Page II. of the month in the Nautical Almanac: the sum will be the sun's apparent altitude.

5. To the observed distance add the semidiameter of the sun, and the moon's augmented semidiameter; their sum will be the apparent distance.

6. But, *if a star or a planet be observed*, from its observed altitude subtract the dip; and the remainder will be the star's or planet's apparent altitude.

7. To the observed distance of the moon and star, or planet, add the moon's augmented semidiameter, if the nearest limb were taken, but subtract it, if the farthest limb were observed: their sum or difference will be the apparent distance.

To find the true Distance.‡

METHOD I.

Rules.—1. To the sum of the apparent altitudes add the difference of the correction of the moon's apparent altitude (XXX.), and that of the sun, star, or planet*, which will give the sum of their true altitudes; subtract this from 180°, and the remainder will be the sum of their true zenith distances.

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* See Note, Page 186.

† In all cases the observed altitudes and distances must *first* be corrected for the index error (if any) of the instrument.

‡ Five different methods of clearing the distance are here given: the first is a modification of Mr. Krafft's Method by natural versed Sines; the second is derived from that of M. Borda, abridged by the Table of Logarithmic Differences, and requires six places of figures in the logarithms; the third is similar to that given by Mr. Witchell, and requires only four places of figures; the fourth was invented by Mendoza Rios, Esq., and has the advantage of not requiring any distinction of cases; the fifth is Mr. Lyon's, improved by using a set of *Linear Tables*, invented and published by the Author of this Work. These Tables, for correcting the apparent distance for the effect of refraction without calculation, render this method one of the easiest and shortest that have been proposed.

2. Under the sum of the apparent altitudes place the auxiliary arc (XXX*.)† and the apparent distance: call these A, B, and C.

3. Find the sum and difference of the auxiliary arc (B), and the sum of the apparent altitudes (A), also the sum and difference of the auxiliary arc (B), and the apparent distance (C); place these in order under each other, together with the sum of the true zenith distances.

4. Add together the natural versed sines (XXXVI). of the five arcs, placing the parts for seconds opposite each, and their sum, together with the sum of the parts, will be the natural versed sine of the true distance.

Note. 1. Since the true distance will never differ much more than a degree from the apparent distance, it will suffice to take out only the last five figures of the natural versed sines, observing to reject the tens in the last line added up.

2. When any of the arcs exceed 180°, subtract them from 360°, and take out the natural versed sine of the remainder.

METHOD II.

Rules.—1. To the sum of the apparent altitudes add the difference of the correction of the moon's apparent altitude (XXX.), and that of the sun, star, or planet*, which will give the sum of their true altitudes, of which take the half.

2. Add together the apparent altitudes and apparent distance, and find the difference between half this sum and the apparent distance.

3. To the log co-sines of the half-sum and difference (XXV.) add the logarithmic difference (XXXIX.)‡, and half the sum of these three logarithms will be the log. sine of an arch.

4. Add together the log. co-sines of the sum and difference of the arch, and half the sum of the true altitudes; then will half the sum of these two logarithms be the log. sine of half the true distance.

Note. In this method it may be observed that the seconds of the apparent distance may be omitted until the operation be finished, and then they are to be added to the computed distance. If the sum of the apparent distance and altitudes should have an odd digit in the unit's place of the minutes, the minutes in the distance may be increased by an unit; and, in this case, what the given number of seconds wants of 60″, is to be subtracted from the computed distance.

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* The *sun's* correction is the difference of the refraction (IV.) and parallax in altitude (VI.), which may be found at once in Table XVIII. The *star's* correction is the refraction in altitude (IV. or XVIII.) The *planet's* correction is the difference of the refraction (IV.) and parallax in altitude (XLVIII.)

† The auxiliary arc may be taken out at the same time with the moon's correction, being placed on the opposite page, taking care always to add the seconds given in the right-hand column, when the distance from the sun or a star be observed; or those in Table L. when the object is a planet

‡ When the sun or a star is observed, the logarithmic difference is to be corrected by Table XL. or XLI.; but when the object is a planet, by Table XLIX.

METHOD III.

RULES.—1. Add the sun's, star's, or planet's apparent altitude to the moon's apparent altitude, and take half their sum; subtract the less altitude from the greater, and take half the difference; then add together
the log. co-tangent of half the sum (XXV.);
the log. tangent of half the difference;
and the log. co-tangent of half the apparent distance:
their sum, rejecting the tens in the index, will be the log. tangent of an arch, which call A.

2. When the sun's, star's, or planet's altitude is greater than the moon's, take the difference between the arch A, and half the apparent distance; but if less, take their sum; then add together
the log. co-tangent of this sum or difference;
the log co-tangent of the sun's, star's, or planet's apparent altitude;
and the proportional logarithm (XXXIV.) of the sun's, star's, or planet's correction*; their sum, rejecting the tens in the index, will be the proportional logarithm of the *first correction.*

3. If the sum of the arch A, and half the apparent distance, were taken in the preceding article, now take their difference; but if their difference were then taken, now take their sum; then add together
the log. co-tangent of this sum or difference;
the log. co-tangent of the moon's apparent altitude;
and the proportional log. (XXXIV.) of the moon's correction (XXX.);
their sum, rejecting the tens in the index, will be the proportional logarithm of the *second correction.*

4. When the arch A is less than half the apparent distance, the first correction must be added to, and the second correction subtracted from the apparent distance; but when the arch A is greater, both the first and second corrections are to be added to the apparent distance, if the moon's altitude be the greater; but when the moon's altitude is the less, they are both to be subtracted from it, to give the corrected distance.

5. Enter Table XXXV. with the corrected distance at the top or bottom, and the moon's correction and second correction alternately in the side column: the difference between the seconds thus taken out, being added to the corrected distance, when it is less than 90°, or subtracted from it when above, will give the true distance.

METHOD IV.

RULES.—1. Add together the apparent distance and apparent altitudes, and take half their sum; the difference between the half-sum and the sun's, star's, or planet's apparent altitude, call the *first remainder;* and the difference between the half-sum and the moon's apparent altitude, call the *second remainder.*

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* See Note * at the bottom of the preceding Page.

2. Add together
   the log. sine of the apparent distance;
   the log. co-sine of the moon's apparent altitude;
   the log. secant of the half-sum;
   the log co-secant of the first remainder;
   the proportional log. (XXXIV.) of the moon's correction (XXX.);
   and the constant logarithm 9.6990:

their sum, rejecting the tens in the index, will be the proportional logarithm of the first correction.

3. Add together
   the log. sine of the apparent distance (already found);
   the log. co-sine of the sun's, star's, or planet's apparent altitude;
   the log. secant of the half-sum (already found);
   the log. co-secant of the second remainder;
   the proportional log. (XXXIV.) of the sun's, star's, or planet's correction*;
   and the constant logarithm 9.6990:

their sum, rejecting the tens in the index, will be the proportional logarithm of the second correction.

4. The difference between the first correction and the correction of the moon's altitude, call the difference of corrections.

Enter Table XXXV. with the apparent distance at the top, and the moon's correction in the side column, and the corresponding number will be the third correction; in the same column, and opposite the difference of corrections, will be found the fourth correction.

5. Subtract the sum of the moon's correction, and the second and fourth corrections, from the apparent distance; to the remainder add the sun's, star's, or planet's correction, and the first and third corrections: their sum will be the true distance.

METHOD V

1. To the apparent distance add the correction taken from the Linear Tables; the sum will be the distance corrected for refraction.

2. Add together the sine of the corrected distance (XXV.), the co-secant of the sun's, star's, or planet's apparent altitude, and the proportional logarithm (XXXIV.) of the moon's horizontal parallax; the sum, rejecting 20 in the index, will be the proportional logarithm of the *first arch*.

3. Add together the tangent of the corrected distance, the co-secant of the moon's apparent altitude, and the proportional logarithm of the moon's horizontal parallax; the sum, rejecting 20 in the index, will be the proportional logarithm of the *second arch*.

4. *When the distance is less than* 90°, the difference of the first and second arches is a *correction for parallax*; which, subtracted from the corrected distance when the first arch is the greater, or added to it when the first arch is the less, the sum or remainder will be the distance corrected for the moon's parallax.

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* See Note * at the bottom of Page 267.

But, *when the distance is greater than* 90°, the sum of the two arches is a *correction for parallax*, and is always to be subtracted from the corrected distance.

5. Enter Table XXXV., and from the column marked with the distance at the top, opposite the moon's parallax in altitude* in the left side column, take out a number of seconds answering thereto; then in the column with the distance at the top, opposite the correction for parallax, find another number of seconds; the difference between these being added to the distance corrected for refraction and parallax, when it is less than 90°, or subtracted from it when above, the sum or remainder will give the true distance.

NOTE. If the moon's distance from the *sun* be observed, it may be further corrected for the parallax of the latter by Table A. (Linear Tables), which gives two small corrections, to be found under the apparent altitudes, and opposite the distance, to be applied as directed at the head of the column containing the distance†. It may, however, be observed that the error, arising from the omission of these corrections, will seldom amount to more than two or three seconds, and in no case can exceed nine seconds; they therefore need only be applied when the distance is required to the nearest second.

But if the moon's distance be taken from the centre of the Planets *Venus* or *Mars*, it should be corrected for the effect of their parallax, by entering Table A with the distance and altitudes, as directed for the sun, using the altitude of the planet instead of that of the sun; then multiply the correction so found by the horizontal parallax of the planet‡, and divide the product by 9: the quotient will be the correction for the planet's parallax, to be applied to the distance by addition or subtraction, as directed for the sun. The parallaxes of the Planets *Jupiter* and *Saturn* are too small to require notice.

Having the true Distance, to find the Longitude.

1. Among the distances of the moon's centre from the sun, a star, or planet, set down for every third hour of Greenwich time, from Page XIII. to XVIII. of each month in the Nautical Almanac, find the two distances between which the true distance falls on the given day of the month at Greenwich, and take out the intermediate proportional logarithm from the column headed "P. L. of Diff."; subtract this prop. log. from the prop. log. (XXXIV.) of the difference between the true distance and that under the next less hour; the remainder will be the prop. log. of a portion of time, which added to the above-mentioned next less hour, the sum will be the mean time at Greenwich.

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* The moon's parallax in altitude is found by Table B. (Linear Tables), under the moon's horizontal parallax, and opposite the moon's altitude.

† When both corrections are additive or subtractive, their sum is to be added or subtracted, but if one be additive, and the other subtractive, their difference is to be added or subtracted according to that of the greater.

‡ The horizontal parallaxes of the planets are given in the Nautical Almanac for 1866, from Pages 301 to 323

But, as the distances in the Nautical Almanac do not increase or decrease uniformly, on account of the irregularity of the moon's motion, *when extreme accuracy is desired*, a number of seconds should be applied to the above Greenwich time, (especially when the prop. logs., opposite the distances in the Almanac, increase or decrease by considerable differences), which may be found as directed in the Explanation to Table LIV.; or by a Table given in Page 498 of the Almanac for 1866.

2. Find the difference between the mean time at Greenwich and the mean time at the ship*; convert this difference into degrees and minutes (XIX), and it will give the true longitude of the ship: East, if the time at the ship be *greater* than the time at Greenwich (reckoning from noon of the same date); but West, if the time at the ship be *less* than the time at Greenwich.

EXAMPLE I.

May 6, 1866, about 8h. 23m. A.M., mean time at ship, in latitude 37° 13′ N., and longitude by account 65° 30′ W., suppose the angular distance between the sun and moon was observed to be 106° 22′ 30″; the altitude of the sun's lower limb at the same time being 38° 44′ 40″; and the altitude of the moon's upper limb 18° 46′ 15″; with the height of the observer's eye 18 feet:—required the true longitude of the ship at time of observation.

	h.	m.	
Est m^{n}. time at ship 8h. 23m. A.M. 6th =	20	23	May 5.
Long. 65° 30′ in time (XIX) ...	4	22	W.
	24	45	
	24		
Est. mean time at Greenwich ...	0	45	May 6.

	′	″
Moon's semidiameter at noon.........	15	15
Moon's horizontal parallax at noon...	55	54

	°	′	″
Obs. altitudes of sun's lower limb...	38	44	40
Dip of Horizon (Table V.)	−	4	4
	38	40	36
Sun's semidiameter (p. II. N.A.)...	+	15	53
Sun's apparent altitude...............	38	56	29

	°	′	″
Observed distance, sun and moon	106	22	30
Sun's semidiameter (p. II N.A.)	+	15	53
Moon's semidiameter + 15′ 15″ Moon's aug. (VII.) + 6	+	15	21
Apparent distance, sun and moon	106	53	44

	°	′	″
Obs. altitude of moon's upper limb	18	46	15
Dip of Horizon (Table V.)	−	4	4
	18	42	11
Moon's aug. semidiam *(from above)*	−	15	21
Moon's apparent altitude	18	26	50

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* If either of the objects employed in the lunar observation be far enough from the meridian, the time at the ship is to be found from its altitude by the Rules in Pages 230, 233, 236, or 238; but if both these be too near the meridian, or the altitudes cannot well be depended on (although they may be sufficiently exact for clearing the distance), the time at the ship, and thence the error of the watch or chronometer, must be found either before or after the distance is taken, and the error applied to the mean of the times given by the same watch, when the distance is observed (as in the fourth and fifth examples); and it must be understood that in this case the longitude deduced from the lunar observations, will be that of the ship, at the time the error of the watch was ascertained.

"Lyon's Method *improved*," *by* Coleman's *Lunar and Nautical Tables**.

	°	′	″				
Moon's horizontal parallax	0	55	54	Pro. Log.	0.50786	....	0.50786
Sun's apparent altitude	38	56½	–	Co-secant	0.20167		
Moon's apparent altitude	18	27	–	Co-secant		....	0.49966
Apparent distance	106	53	44	Sine......	9.98083	Tangent......	0.51738
First arc .... +	4	23	17	Pro. Log.	0.69036		
Second arc.......................... +	4	54	38	....		Pro. Log.	1.52490
Third arc	+	2	55				
True Distance—*Sub.* 10° = ...	106	14	34				

METHOD I.

By Krafft, *or Natural Versed Sines.*—Vide *Rules pp.* 266 *and* 267.

	′	″		°	′	″
☽'s app. alt. 18° 20′ and hor. par. 55′...	49	12	(XXX.) ....(XXX.*)	60	9	6
Parts for 7′ of altitude	+	9	....		+	4
Parts for 54′ of parallax	+	51	....		+	10
			Parts for sun's app. alt. 39°.........		+	3
Moon's correction............................	50	12				
			Auxiliary arc	60	9	23

	°	′	″
Sun's apparent altitude	38	56	29
Moon's apparent altitude	18	26	50
Sum of apparent altitudes (A) ...	57	23	19
Auxiliary arc................ (B) ...	60	9	23
Apparent distance .... (C) ...	106	53	44
Sum of A and B	117	32	42
Diff. of A and B	2	46	4
Sum of B and C	167	3	7
Diff. of B and C	46	44	21
Sum of true zenith distances	121	47	32
True Distance	106	14	33

	°	′	″
Sum of apparent altitudes	57	23	19
Moon's corr. (XXX.) + 50′ 12″ Sun's corr. (XVIII.) + 1 3	+	49	9
Sum of true altitudes	58	12	28
	180		
Sum of true zenith distances	121	47	32

Versed...62265	Parts for seconds ...	181
Versed...01166	....	1
Versed...74566	....	7
Versed ..14605	....	73
Versed...26709	....	132
394	Sum of the parts ...	394
Versed...79705		

METHOD II.

By M. Borda, *abridged by the Log. differences* —Vide *Rules p.* 267.

	°	′	″
Sun's app altitude	38	56	29
Moon's app. altitude ...	18	26	50
Sum of app. altitudes...	57	23	19
Moon's corr. + 50′ 12″ Sun's corr. – 1 3	+	49	9
Sum of true altitudes...	58	12	28
Half-sum	29	6	14
Arc	20	34	50
Sum	49	41	4
Difference	8	31	24
	°	′	″
	53	7	16½
		×	2
True Distance	106	14	33

	°	′	″		
....	38	56	29		
....	18	26	50		
Apparent distance ...	106	53	44		
Sum	164	17	3	Log. diff ...	9.997942
Half-sum..............	82	8	31½	Co-sine ...	9.135822
Diff. of do. and app. dist.	24	45	12½	Co-sine ...	9.958142
					2)19.091906
....				Sine	9.545953
....				Co-sine ...	9.810902
....				Co-sine ...	9.995177
					2)19.806079
....				Sine	9.903039

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* These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

METHOD III.

By Witchell, *requiring only Four Places of Figures.*—Vide *Rules, p.* 268.

	° ′				
Sun's apparent altitude.	38 56½				
Moon's apparent altitude	18 27		° ′		
Sum of app. altitudes ...	57 23½	Half	28 41	Co-tangent.	0.2619
Difference	20 29½	Half	10 15	Tangent ...	9.2573
Apparent distance	106 53 44″	Half	53 27	Co-tangent.	9.8700
First correction	+ 0 42	Arc A.	13 46	Tangent ...	9.3892
	106 54 26	Diff	39 41	Co-tangent.	0.0811
Second correction	− 39 52	Sun's apparent altitude ...	38 56½	Co-tangent.	0.0925
		Sun's correction	1′ 3″	Pro. Log. ...	2.2341
	106 14 34	First correction	0 42′	Pro. Log. ...	2.4077
Third correction	− 2	Sum	67° 13′	Co-tangent.	9.6233
		Moon's apparent altitude.	18 27	Co-tangent.	0.4767
TRUE DISTANCE	106 14 32	Moon's correction	50′ 12″	Pro. Log. ...	0.5546
		Second correction	39 52	Pro. Log ...	0.6546

METHOD IV.

By Mendoza Rios, *having no Distinction of Cases.*—Vide *Rules, pp.* 268 *&* 269.

	° ′					° ′ ″
Apparent distance	106 54	Sine	9.9808	9.9808	Moon's corr. ...	− 50 12
Moon's app. altitude ...	18 27	Co-sine ...	9.9771		Second corr. ...	− 21
Sun's app. altitude	38 56½	Co-sine		9.8908	Fourth corr. ...	− 16
Sum	164 17½					− 50 49
Half-sum	82 9	Secant ...	0.8646	0.8646	App. distance.	106 53 44
First remainder	43 12½	Co-secant.	0.1646			106 2 55
Second remainder	63 42	Co-secant.		0.0475	Sun's corr. ...	+ 1 3
Sun's correction	1′ 3″	Pro. Log.		2.2341	First corr.	+ 10 20
Moon's correction	50 12	Pro. Log.	0.5546		Third corr. ...	+ 14
	′ ″	Const.Log	9.6990	9.6990	TRUE DIST.	106 14 32
First correction	10 20	Pro. Log.	1.2407	P.L. 2.7168	Second corr. 21″	
Diff. of corrections	39 52					

METHOD V.

By Norie's *Linear Tables.*—Vide *Rules, pp.* 269 *and* 270.

	° ″				
Apparent distance	106 53 44				
Correction for refraction	+ 2 56				
Corrected distance	106 56 40	Sine	9.9807	Tangent...	0.5162
Sun's apparent altitude	38 56½ −	Co-secant ...	0.2017		
Moon's apparent altitude ...	18 27 −	Co-secant			0.4997
Moon's horizontal parallax...	55 54	Pro. Log.	0.5079		0.5079
First arc	− 36 44	Pro. Log.	0.6903		
Second arc	− 5 23			Pro. Log. ...	1.5238
Correction for parallax	− 42 7		42′ gives	16″	(XXXV.)
Corrected distance	106 56 40	Parallax in altitude	43	16	
	106 14 33			—	
Third correction	0			0	
TRUE DISTANCE	106 14 33			—	

To find the Mean Time at Greenwich.

True distance (Method I.) ...	106° 14′ 34″		
Distance at 0 hour by N. A. –	106 35 50	......and Pro. Log.	0.3152
Difference	21 16	.... Pro. Log. ...	0.9276
	h. m. s.		
Proportional part of time	0 43 56	.... Pro. Log. ...	0.6124
Time of distance by N. A. ...	0 0 0		
Mean time at Greenwich	0 43 56	May 6.	
Or	24 43 56	May 5.	

To find the Mean Time at Ship, and thence the Longitude.

Sun's apparent altitude...	38° 56′ 29″	Sun's declination, May 6, (p. II. N. A.)...	16° 32′ 56″ N.
Sun's correction (XVIII.)	– 1 3	Correction for 0h. 44m.	+ 0 32
Sun's true altitude	38 55 26	Sun's declin. at Greenwich time............	16 33 28 N.
			90
		Sun's polar distance	73 26 32

	° ′			
Polar distance	73 26½...	Co-secant	0.01839	
Latitude	37 13 ...	Secant	0.09889	
Sun's true altitude	38 55½			
Sum	149 35			
Half-sum	74 47½...	Co-sine	9.41885	
Remainder	35 52 ...	Sine	9.76782	
	h. m. s.			
Time from noon	3 33 18	Log............	9.30395	(XXXI.)
	24			

				m. s.
Apparent time at ship...	20 26 42			
Equation of time.........	– 3 34		Equation of time May 6 by N.A.	3 33.36
Mean time at ship	20 23 8	May 5.	Correction for 44 min.	+ 0.15
Mean time at Greenwich	24 43 56	May 5.	Equation at Greenwich time ...	3 33.51
Longitude in time	4 20 48	= 65° 12′ West.		

EXAMPLE II.

August 22, 1866, P. M. at ship, in latitude 27° 49′ S., and longitude by account 1° 00′ E., when a chronometer (which was 2m. 30s. *slow* of Greenwich mean time) shewed 7h. 38m. 40s., suppose the distance of the moon's *nearest limb* from the Star α Virginis (Spica) was observed to be 87° 12′ 30″; at the same time the altitude of the moon's lower limb was 66° 45′ 10″: and the altitude of the star (when *westward* of the meridian) 24° 15′ 20″; the height of the observer's eye 20 feet, and instruments properly adjusted: required the true longitude of the ship by lunar observation and chronometer.

	h. m. s.		′ ″		′ ″
Time by Chron. ...	7 38 40 Ag. 22.	☽'s semid. at noon	15 10	Hor. par. at noon ...	55 34
Chronometer *slow*	+ 2 30	Corr. for 7h. 41m.	+ 3	Corr. for 7h. 41m ...	+ 12
Mean time at Green.	7 41 10 Ag. 22.	*☽'s sem. at Gr. time*	15 13	*Hor. par. Green. time*	55 46
			° ′ ″		° ′ ″
		Obs. alt. ☽'s L.L.	66 45 10	Observed dist. ...	87 12 30
	° ′ ″	Dip of horizon.	– 4 17	Index error	0 0
Star's obs. altitude.	24 15 20		66 40 53		87 12 30
Dip of horizon......	– 4 17	☽'s aug. semid.	+ 15 28	☽'s sem. 15′ 13″ Aug (VII) + 15	+ 15 28
Star's app. altitude.	24 11 3	☽'s app. altitude	66 56 21	Apparent dist. ...	87 27 58

"LYON'S METHOD *improved*," *by* COLEMAN'S *Lunar and Nautical Tables.*[*]

	°	′	″				
Moon's horizontal parallax	0	55	46	Pro. Log.	0.50890		0.50890
Star's apparent altitude	24	11	—	Co-secant	0.38758		
Moon's apparent altitude	66	56	—	Co-secant			0.03618
Apparent distance	87	27	58	Sine	9.99958	Tangent...	1.35415
First arc +	4	37	8	Pro. Log.	0.89606		
Second arc +	5	2	16			Pro Log.	1.89923
Third arc +		2	28				
TRUE DISTANCE—*Sub.* 10° =	87	9	50				

METHOD I.

By KRAFFT, *or Natural Versed Sines.*—Vide *Rules, pp.* 266 *and* 267.

	′	″
☽'s app alt. 66° 50′ and hor par. 55′ =	21	4
Parts for 6′ of altitude	+	5
Parts for 46′ of parallax	+	18
Moon's correction	21	27

	°	′	″
(XXX) ... (XXX*)	60	28	5
		+	1
		+	24
Parts for star's app. alt. 24°		+	0
Auxiliary arc	60	28	30
Sum of apparent altitudes	91	7	24
Moon's corr. (XXX.) + 21′ 27″ Star's corr. (XVIII) − 2 6	+	19	21
Sum of true altitudes	91	26	45
	180		
Sum of true zenith distances	88	33	15

	°	′	″			
Star's apparent altitude	24	11	3			
Moon's apparent altitude	66	56	21			
Sum of apparent altitudes (A)	91	7	24			
Auxiliary arc (B)	60	28	30			
Apparent distance (C)	87	27	58			
Sum of A and B	151	35	54	Versed... 79510	Parts for seconds...	126
Diff. of A and B	30	38	54	Versed... 39554		134
Sum of B and C	147	56	28	Versed... 47431		74
Diff. of B and C	26	59	28	Versed... 08861		60
Sum of zenith distances	88	33	15	Versed... 74695		73
	°	′	″	467	Sum of the parts...	467
TRUE DISTANCE	87	9	49	Versed... 50518		

METHOD II.

By M. BORDA, *abridged by the Log. differences.*—Vide *Rules, p.* 267.

	°	′	″		°	′	″		
Star's app. altitude	24°	11′	3″		24°	11′	3″		
Moon's app. altitude	66	56	21		66	56	21		
Sum of app. altitudes	91	7	24	Apparent distance	87	27	58		
Moon's corr. + 21′27″ Star's corr. − 2 6	+	19	21	Sum	178	35	22	Log. diff...	9.993698
				Half-sum	89	17	41	Co-sine	8.090227
Sum of true altitudes 2)	91	26	45	Diff. of do. and app. dist.	1	49	43	Co-sine	9.999779
Half sum	45	43	22½					2)	18.083704
Arc	6	19	19					Sine	9.041852
Sum	52	2	41½					Co-sine	9.788906
Difference	39	24	3½					Co-sine	9.888024
	°	′	″					2)	19.676930
	43	34	54½					Sine	9.888465
		×	2						
TRUE DISTANCE	87	9	49						

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[*] These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

METHOD III.

By WITCHELL, *requiring only Four Places of Figures.*—Vide *Rules, p.* 268.

	° ′		° ′		
Star's apparent altitude.	24 11				
Moon's apparent altitude	66 56				
Sum	91 7	Half	45 33½	Co-tangent.	9.9915
Difference	42 45	Half	21 22½	Tangent	9.5926
Apparent distance	87 27 58″	Half	40 44	Co-tangent.	9.0192
First correction	+ 2 5	Arc A.	21 51½	Tangent	9.6033
		Sum	65 35½	Co-tangent.	9.6569
	87 30 3	Star's apparent altitude	24 11	Co-tangent.	0.3477
Second correction	− 20 14	Star's correction	2′ 6″	Pro. Log.	1.9331
	87 9 49	First correction	2 5	Pro. Log.	1.9377
Third correction	− 0	Difference	21°52½′	Co-tangent.	0.3963
		Moon's apparent altitude.	66 56	Co-tangent.	9.6293
TRUE DISTANCE	87 9 49	Moon's correction	21′ 27″	Pro. Log.	0.9238
		Second correction	20 14	Pro. Log	0.9494

METHOD IV.

By MENDOZA RIOS, *having no Distinction of Cases.*—Vide *Rules, pp.* 268 *&* 269.

	° ′					° ′ ″
Apparent distance	87 28	Sine	9.9996	9 9996	Moon's corr −	0 21 27
Moon's app. altitude	66 56	Co-sine	9.5931		Second corr.	− 1
Star's app. altitude	24 11	Co-sine		9.9601	Fourth corr.	− 0
Sum	178 35					− 0 21 28
Half-sum	89 17½	Secant	1.9029	1.9029	App. distance.	87 27 58
First remainder	65 6½	Co-secant.	0.0423			87 6 30
Second remainder	22 21½	Co-secant.		0.4197	Star's corr.	+ 2 6
Star's correction	2′ 6″	Pro. Log.		1.9331	First corr.	+ 1 15
Moon's correction	21 27	Pro. Log.	0.9238		Third corr.	+ 0 0
	′ ″	Const.Log	9.6990	9.6990	TRUE DIST.	87 9 51
First correction	1 15	Pro. Log.	2.1607	P.L. 3.9144	Second corr. 1″	
Diff. of corrections	20 12					

METHOD V.

By NORIE'S *Linear Tables.*—Vide *Rules, pp.* 269 *and* 270.

	° ′ ″					
Apparent distance	87 27 58					
Correction for refraction	+ 2 30					
Corrected distance	87 30 28	Sine	9.9996	Tangent	1.3613	
Star's apparent altitude	24 11 −	Co-secant	0.3876			
Moon's apparent altitude	66 56 −	Co-secant			0.0362	
Moon's horizontal parallax	55 46	Pro. Log.	0.5089		0.5089	
First arc	− 22 52	Pro. Log.	0.8961			
Second arc	+ 2 14			Pro. Log.	1.9064	
Correction for parallax	− 20 38		21′ gives	0″		(XXXV.)
Corrected distance	87 30 28	Parallax in altitude	22	0		
	87 9 50			—		
Third correction	0			0		
TRUE DISTANCE	87 9 50			—		

To find the Mean Time at Greenwich.

	°	′	″		
True distance (Method V.)............	87	9	50		
Distance at VI. hours by N. A.......	86	17	22	.... and Pro. Log	0.2815
Difference..................................	0	52	28	.... Pro. Log	0.5354
	h.	m.	s.		
Proportional part of time................	1	40	19	.... Pro. Log	0.2539
Time of Distance by Naut. Alm. ...	6				
Mean time at Greenwich	7	40	19	Aug 22.	

To find the Mean Time at Ship, and thence the Longitude, by the Lunar Observation and Chronometer.

	°	′	″		h.	m.	s.
Star's apparent altitude	24	11	3	Star's right ascension, January 1860,	13	17	49
Star's corr. (XVIII.)	–	2	6	Ann. var. + 3s. 15 × $6\frac{2}{3}$ = 21s. 00 = ...		+	21
Star's true altitude	24	8	57	Star's right ascension, August 1866,	13	18	10
	h.	m.	s.		°	′	″
Sun's right ascen. (p. II. N. A.).	10	4	59	Star's declination, January, 1860 ...	10	25	44S.
H. diff. 9s. 227 × $7\frac{2}{3}$h. = 70s. 73 =	+	1	11	Ann. var. + 18″. 96 × $6\frac{2}{3}$ = 124″. 40 =	+	2	4
Sun's R. A. at Green. time	10	6	10	Star's declination, August 1866......	10	27	48S.
					90		
				Star's polar distance......................	79	32	12

	°	′		
Star's polar distance	79	32	......Co-secant...	0.00729
Ship's latitude	27	49	......Secant	0.05333
Star's true altitude.........	24	9		
Sum...	131	30		
Half-sum......................	65	45	......Co-sine ...	9.61355
Remainder	41	36	......Sine	9.82212

	h.	m.	s.				
Star's dist. from merid.	4	32	25	W...Log .... 9.49629 (XXXI.)			
Star's right ascension .	13	18	10			m.	s.
				Equation of time, (p. 1. N. A.)		2	43.39
Right ascen. of merid.	17	50	35	Hourly diff. 0s. 334 × $8\frac{2}{3}$		–	4.81
Sun's right ascension .	10	6	10				
				Equation at Greenwich time		2	38.58
Apparent time at ship	7	44	25				
Equation of time	+	2	39		h.	m.	s.
Mean time at ship ...	7	47	4	Aug. 22.	7	47	4 Aug. 22.
Mean time at Green. .	7	40	19	Aug. 22. Mean time by chron.	7	41	10 Aug. 22.
Longitude in time by lunar observation	0	6	45	= 1° 41′ 15″ E. Long. in time by Chro.	0	5	54 = 1° 28′ 30″ E.

NOTE. The star's right ascension and declination may be taken from the Nautical Almanac answering to the given day, *or the nearest one to it*, by which the time and trouble of computing the star's position (as worked above) will be saved, *viz.*—

	h. m. s.
* Spica's right ascension, page 361 of Nautical Almanac, Aug. 22...	13 18 10
* Spica's declination, page 361 of Nautical Almanac, Aug. 22.........	10° 27′ 46″ S.

EXAMPLE III.

June 20, 1866, in latitude 41° 27′ N., and longitude by account 13° 00′ E. about 7h. 30m. P.M. mean time at ship, suppose the angular distance of the moon's *remote limb* from the centre of the Planet Venus to be 69° 59′ 40″, at the same time the altitude of the moon's *upper limb* was 43° 30′ 15″; and the altitude of the planet's centre 21° 32′ 20″ (*westward* of the meridian); the observer's eye being 30 feet, and the instruments adjusted, except the sextant, with which the distance was taken, the error of it being 2′ 15″ to add: required the true longitude of the ship

	h.m.
Time at ship ..	7 30 June 20
Long. in time..	— 52 E.
Greenwich time	6 38 June 20
	° ′ ″
Venus' obs. altitude..	21 32 20
Dip of horizon	— 5 15
Venus' app. altitude..	21 27 5

	′ ″
☽'s hor. par. at noon....	55 0
Corr. for 6h. 38m. (LV.)	— 9
☽'s hor. par. Gr. time ..	54 51
	° ′ ″
Obs. alt. moon's U.L.	43 30 15
Dip of horizon......	— 5 15
	43 25 00
Moon's semid. aug..	— 15 10
Moon's app. altitude.	43 09 50

	′ ″
☽'s semidiam. at noon ..	15 1
Corr. for 6h. 38m. (LV.)	— 2
☽'s semid. at Gr. time ..	14 59
	° ′ ″
Observed dist. R. L.	69 59 40
Index error, *to add.*	+ 2 15
	70 01 55
☽'s semid.—14′ 59″ Moon's aug.+ 11	— 15 10
Apparent distance ..	69 46 45

"LYON'S METHOD *improved,*" *by* COLEMAN'S *Lunar and Nautical Tables.**

	° ′ ″		
Moon's horizontal parallax	0 54 51	Pro Log. 0.51610	0.51610
Venus' apparent altitude............	21 27 —	Co-secant 0.43689	
Moon's apparent altitude............	43 10	Co-secant	0.16487
Apparent distance....................	69 46 45	Sine 9.97239	Tangent........ 0.43385
First arc.........................+	4 38 38	Pro Log. 0.92538	
Second arc ....+	5 13 49	....	Pro Log. 1.11482
Third arc	+ 1 52		
SUM *lessened by* 10° = ...	69 41 4		
Correction for Venus' parallax	— 4		
TRUE DISTANCE	69 41 0		

METHOD I.

By KRAFFT *or Natural Versed Sines.*—Vide *Rules pp.* 266 *and* 267.

	′ ″
Moon's app. alt. 43° 10′, and hor. par. 54′ =	38 12
Parts for 9′ of altitude	+ 10
Parts for 51″ of parallax	+ 37
Moon's correction	38 59
Refraction for Venus' alt. (XVIII.) ..—	2′ 24″
Venus' parallax in alt. (XLVIII.)....	+ 6
Venus' correction ....—	2 18
Venus' apparent altitude............	21° 27′ 05″
Moon's apparent altitude	43 09 50
Sum of apparent altitudes (A)........	64 36 55
Auxiliary arc .... (B)........	60 20 42
Apparent distance ...... (C)........	69 46 45
Sum of A and B....................	124 57 37
Diff of A and B....................	4 16 13
Sum of B and C...	130 17 27
Diff. of B and C....................	9 26 3
Sum of true zenith distances	114 46 24
TRUE DISTANCE	° ′ ″ 69 40 59

	° ′ ″
(XXX.)................ (XXX.*)	60 20 20
....	+ 0
....	+ 21
Venus' alt. 21° and hor. par. 6″ (L) ..	+ 1
Auxiliary arc........................	60 20 42
Sum of apparent altitudes	64 36 55
Moon's corr. (XXX) + 38′ 59 Venus' correction .... — 2 18	+ 36 41
Sum of the true altitudes............	65 13 36
	180
Sum of true zenith distances	114 46 21

Versed.. 72861	Parts for seconds ..	148
Versed.. 02771	....	5
Versed.. 44346	....	100
Versed.. 13523	....	2
Versed.. 18924	....	106
361	Sum of the parts ..	361
Versed.. 52786		

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* These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

METHOD II.

By M. Borda, *abridged by the Log. differences.*—Vide *Rules, p.* 267.

	° ′ ″		° ′ ″		
Venus' app. altitude ...	21 27 5	....	21 27 5		
Moon's app. altitude ...	43 9 50	....	43 9 50		
		Apparent distance	69 46 45		
Sum of app. altitudes ...	64 36 55				
Moon's corr. + 38′ 59″	+ 36 41	Sum	134 23 40	... Log. diff....	9.995442
Venus' corr. − 2 18		Half-sum	67 11 50	... Co-sine.....	9.588339
		Diff.ofdo.&app.dist.	2 34 55	... Co-sine......	9.999559
Sum of true altitudes ...	65 13 36				
				2)	19.583340
Half-sum	32 36 48				
Arc	38 14 27½	....		Sine	9.791670
Sum	70 51 15½	....		Co-sine......	9.515836
Difference	5 37 39½	....		Co-sine......	9.997002
	° ′ ″			2)	19.513738
	34 50 29	....		Sine	9.756869
	× 2				
True Distance	69 40 58				

METHOD V.

By Norie's *Linear Tables.*—Vide *Rules, pp.* 269 *and* 270.

	° ′ ″				
Apparent distance	69 46 45				
Correction for refraction ...	+ 1 48				
Corrected distance	69 48 33	...Sine	9.9724	... Tangent...	0.4344
Venus' app. altitude.........	21 27 5	...Co-secant ...	0.4369		
Moon's app. altitude	43 9 50	...Co-secant			0.1649
Moon's hor. parallax	54 51	...Pro. Log.	0.5161	....	0.5161
First arc	− 21 22	...Pro Log. ...	0.9254		
Second arc......................	+ 13 48	....		Pro. Log...	1.1154
Correction for parallax......	− 7 34	.... 8′ gives 0″	(XXXV.)		
Corrected distance	69 48 33	☽'s parallax in alt.... 40 „ 5			
	69 40 59		—		
Third correction	+ 5	....	5″		
	69 41 4				
Corr. for Venus' parallax...	− 4				
True Distance	69 41 0				

To find the Mean Time at Greenwich.

True distance (Method V.)	69°41′ 0″		
Distance at VI. hours by N. A...	69 24 11	..................and Pro. Log....	0.3463
Difference.............................	0 16 49	.... Pro. Log....	1.0295
	h m. s.		
Proportional part of time	0 37 20	.... Pro. Log....	0.6832
Time of distance by Naut. Alm...	6		
Mean time at Greenwich	6 37 20 June 20.		

To find the Mean Time at Ship, and thence the Longitude.

	°	′	″
Venus' apparent altitude	21	27	5
Refraction (IV. or XVIII.)	−	2	24
	21	24	41
Parallax in altitude (XLVIII.) ...		+	6
Venus' true altitude	21	24	47

	h	m.	s.
Sun's R. A., June 20, (p. II. N.A.)	5	55	3
s. h.m.			
Hourly diff. + 10.40 × 6. 37 =	+	1	9
Sun's R. A., at Greenwich time ...	5	56	12

To find Venus' R. A. at Greenwich Time.

	h.	m.	s.		
Venus' R.A. June 20,	8	1	35	} (p. 261, N.A.	
Venus' R.A. June 21,	8	6	40		
Variation in 24 hours		5	5	Log.	0.6741
Greenwich time......	6h. 37m.			Log.	0.5596
	h.	m.	s.		
Variation in 6h.37m.	+	1	24*	Log.	1.2337
Venus' R.A June20,	8	1	35		
Ditto at Green. time	8	2	59		

To find Venus' declin. at Greenwich time.

	°	′	″		
Venus' dec. June 20,	22	16	43 N.		
Venus' dec. June 21,	22	2	30 N.		
Variation in 24 hours		14	13	Log.	.2274
Greenwich time	6h. 37m.			Log.	.5596
		′	″		
Variation in 6h.37m.	−	3	55†	Log.	.7870
Venus' dec. June 20,	22	16	43 N		
Ditto at Green. time.	22	12	48 N.		
	90				
Venus' Polar distance	67	47	12		

	m.	s.
Equation, June 20 (p. I. N. A.)	1	10 53
Hourly difference + 0s. 54 × 6h. 37m. = ...	+	3. 60
Equation at Greenwich time..................................	1	14. 13

	°	′			
Venus' polar distance.........	67	47		......Co-secant.........	0.03350
Ship's latitude......	41	27		......Secant	0.12521
Venus' true altitude	21	25			
Sum	130	39			
Half-sum	65	19½		......Co-sine	9.62062
Remainder	43	54½		......Sine	9.84104
	h.	m.	s.		
Venus' meridian distance ...	5	21	53 W	......Log.	9.62037 (XXXI.)
Venus' right ascension	8	2	59		
Right ascension of meridian	13	24	52		
Sun's right ascension.........	5	56	12		
Apparent time at ship	7	28	40		
Equation of time	+	1	14		
Mean time at ship	7	29	54 June 20.		
Mean time at Greenwich ...	6	37	20 June 20.		
Longitude in time	0	52	34 = 13° 8′ 30″ East.		

NOTE. *Or the variation of Venus' right ascension and declination, may be more readily found for Greenwich time, thus:—viz.*

* Var. of R.A. for 1 hour (p. 309. N.A.) is 12s.75 × 6h. 37m. = 85s.00. Corr. for R. Ascen.

† Var. of Dec. for 1 hour (p. 309, N.A.) is 34″.9 × 6h. 37m. = 3′ 53″ Corr. for Declin.

EXAMPLE IV.

August 14, 1866, in latitude 45° 38′ N., and longitude by account 117° 30′ W., suppose the following sets of altitudes and distances were observed at about 11h. 10m. A. M. (*civil time*) at ship, in order to determine the true longitude; the corresponding times being taken by a chronometer, which at the time of observation was 16m. 20s. *fast* for mean time at Greenwich, and was *gaining* 14s. per day; the height of the observer's eye being 20 feet, and the error of each instrument respectively, as stated below.

	Times by Chron.	Obs. alts. ☉'s L.L.	Obs. alts. ☽'s U.L.	Obs. distances.	
	h. m. s.	° ′ ″	° ′ ″	° ′ ″	
	7 14 20	56 20 20	17 49 5	50 29 10	
	15 45	25 30	18 2 25	30 00	
	17 15	30 55	18 15 30	31 00	
	18 30	35 40	18 28 35	31 35	
	19 55	40 55	18 41 55	32 25	
	5) 85 45	5) 153 20	5)91 17 30	5) 154 10	
Means	7 17 9	56 30 40	18 15 30	50 30 50	
Chronometer *fast*	— 16 20	+ 1 10	— 1 10	+ 30	Errors.
Mean time at Greenwich by the chronometer..	7 0 49	56 31 50	18 14 20	50 31 20	

	′ ″		′ ″
Moon's hor. par. at noon, Aug. 14......	55 30	Moon's semid. at noon, Aug. 14	15 9
Ditto at midn. Aug. 14......	55 13	Ditto at midn. Aug. 14	15 4
Difference in 12 hours	17	Difference in 12 hours	5
(Table LV.)........12h. : 17″ : : 7h. :	— 10	(Table LV.) ....12h. : 5″ : : 7h. :	— 3
Moon's hor. par. at noon, Aug. 17	55 30	Moon's semid. at noon, Aug. 17	15 9
Ditto at Greenwich time	55 20	Ditto at Greenwich time......	15 6

	° ′ ″
Obs. alt. sun's L. L.	56 31 50
Dip of Horizon	— 4 17
	56 27 33
Sun's semidiam....	+ 15 50
Sun's app. altitude...	56 43 23

	° ′ ″
Obs. alt. Moon's U. L.	18 14 20
Dip of Horizon	— 4 17
	18 10 3
Moon's aug. semid...	— 15 11
Moon's app. altitude..	17 54 52

	° ′ ″
Observed distance..	50 31 20
Sun's semidiameter.	+ 15 50
☽'s semid. + 15′ 6″ ☽'s aug.(VII.) + 5	+ 15 11
Apparent distance..	51 2 21

"Lyon's Method *improved*," *by* Coleman's *Lunar and Nautical Tables*.*

	° ′ ″			
Moon's horizontal parallax	0 55 20	Pro. Log.	0. 51229................	0. 51229
Sun's apparent altitude	56 43 23	Co-secant	0. 07777	
Moon's apparent altitude	17 54 52	Co-secant	....	0. 51197
Apparent distance	51 2 21	Sine	9. 89074.......Tangent..	0. 09224
First arc	+ 4 0 30	Pro. Log.	0. 48080	
Second arc	+ 5 13 46		......................Tangent..	1. 11650
Third arc	+ 2 20			
True Distance—(*Sub.* 10°) =	50 18 57			

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* These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

METHOD I.

By Krafft, *or Natural Versed Sines.*—Vide *Rules pp.* 266 *and* 267.

	°	′	″
☽'s app. alt. 17° 50′ and hor. par. 55′...		49	16
Parts for 5′ of altitude...		+	9
Parts for 20″ of parallax...		+	19
Moon's correction...		49	44
Moon's apparent altitude ...	17	54	52
Sun's apparent altitude...	56	43	23
Sum of apparent altitudes (A) ...	74	38	15
Auxiliary arc ... (B) ...	60	9	1
Apparent distance ... (C) ...	51	2	21
Sum of A and B. ...	134	47	16
Diff. of A and B. ...	14	29	14
Sum of B and C. ...	111	11	22
Diff. of B and C. ...	9	6	40
Sum of zenith distances...	104	32	34
True Distance ...	15	18	59

	°	′	″
(XXX)...(XXX*)	60	8	50
...		+	3
...		+	4
Parts for sun's app. alt. 57° ...		+	4
Auxiliary arc ...	60	9	1
Sum of apparent altitudes...	74	38	15
Moon's corr. (XXX.) + 49′ 44″ Sun's corr. (XVIII.) − 0 33		+ 49	11
Sum of true altitudes...	75	27	26
	180		
Sum of zenith distances...	104	32	34

Versed...	04428	Parts for seconds	55
Versed...	31780	...	16
Versed...	61353	...	100
Versed...	12586	...	33
Versed...	50943	...	160
	364	Sum of the parts	364
Versed...	61454		

METHOD V.

By Norie's *Linear Tables.*—Vide *Rules, pp.* 269 *and* 270.

	°	′	″				
Apparent distance ...	51	2	21				
Correction for refraction ...	+	2	14				
Corrected distance ...	51	4	35	..Sine...	9.8910	...Tangent...	0.0928
Sun's apparent altitude ...	56	43½	—	...Co-secant ...	9.0778		
Moon's apparent altitude...	17	55	—	...Co-secant...		...	0.5120
Moon's horizontal parallax.	0	55	20	...Pro. Log. ...	0.5123	...	0.5123
First arc...	−	59	27	...Pro. Log. ...	0.4811		
Second arc ...	+	13	45	...		Pro. Log....	1.1171
Correction for parallax...	−	45	42	...	46′ gives 15″	(XXXV.)	
Corrected distance ...	51	4	35	...Parallax in altitude	52 ″ 19		
	50	18	53				
Third correction ...	+		4	...	4″		
True Distance ...	50	18	57				
Distance at VI. h. by N. A.	49	50	42	...		and Pro. Log...	0.3246
Difference ...		28	15	...		Pro. Log...	0.8043
	h.	m.	s.				
Proportional part of time...	0	59	39	...		Pro. Log...	0.4797
Time of distance by N. A..	6						
Mean time at Greenwich...	6	59	39	Aug. 14.			
	24						
Ditto ditto...	30	59	39	Aug. 13.			

The sun being too near the meridian at the time of taking the distances to infer the time from its altitude, the following observations were made at about 3h. 30m. P. M., mean time at ship, in order to determine the error of the chronometer at the meridian of the ship; the latitude being then 45° 2′ N., the longitude by account 117° 18′ W., the height of the observer's eye 20 feet, and the error of the sextant 1′ 10″ to subtract: required the longitude of the ship, by chronometer and lunar observation, when the altitudes were taken.

	Times by Chro. h. m. s.	Obs. alt. ☉'s L. L. ° ′ ″		° ′ ″
	11 35 15	37 0 10	Sun's declin. Aug. 14 (from p. II. of N.A.)	14 22 25N
	36 10	36 46 45	Hour. diff. 46″.30×11⅓h.	– 8 45*
	37 15	36 30 30		
	38 5	36 18 35		
	39 10	36 2 20	Sun's dec. at Green. time	14 13 40N
				90
5)	185 55	182 38 20		
			Sun's polar distance	75 46 20
Mean of times by chronometer.	11 37 11	36 31 40		
Chronometer *gained* in 4½ hours	– 2	– 1 10	Index error	
				′ ″
Mean time by chron. when ☉'s altitudes were observed......	11 37 9	36 30 30	Corr. for 11h. 21m. (XXI)	– 8 57*
Chron. *fast* when dist. was obs.	– 16 20	– 4 17	Dip of horizon.	
Mean time at Green. by chron.	11 20 49	36 26 13		
				m. s.
Corr. (Table XVIII.)		– 1 10	Equation of time Aug. 14 (from p. I. of N.A.) ...	4 27.94
		36 25 3	Hour. diff. – 0s. 46×11⅓h. =	– 5.21
Sun's semidiameter		+ 15 50		
			Equa. at Greenwich time...	4 22.73
Sun's true altitude		36 40 53		

	° ′		
Sun's polar distance	75 46½	...Co-secant...	0.01353
Ship's latitude	45 2	...Secant	0.15077
Sun's true altitude	36 41		
Sum	157 29½		
Half-sum	78 45	...Co-sine......	9.29024
Remainder	42 4	...Sine	9.82607
	h. m. s.		
Apparent time at ship	3 27 13	.........Log	9.28061 (XXXI.)
Equation of time	+ 4 23		

			h. m. s.
Mean time at ship.....................	3 31 36	Aug. 14	3 31 36 Aug. 14
Mean time by chron. when the above altitudes were observed	11 37 9	Mean time at Green. by chron. ...	11 20 49 Aug. 14
Chron. *fast* for mean time at ship...	8 5 33	Long. in time by chr.	7 49 13 = 117° 18′ 15″ W.
Time by chron. when dist. was obs..	31 17 9	past noon, Aug. 13.	
Mean time of obs. distance at ship...	23 11 36	ditto, Aug. 13.	
Mean time at Greenwich when the distance was taken	30 59 39	ditto, Aug. 13.	
Longitude in time when the above error of chronometer was found	7 48 3 = 117° 0′ 45″ West.		

NOTE. The above being the longitudes deduced from the chronometer and lunar observation, at 3h. 31m. 36s. mean time at the ship, August 14, that is, *when the altitudes for time were taken*, they may be reduced to noon, or any other time of the day, by the log.

Thus, suppose it were required to find the longitude of the ship when the distances were observed. By comparing the longitudes by account at both observations, it appears that the ship has made 12 miles of longitude to the east; which being *added* to 117° 0′ 45″ W., the longitude by the lunar observation, when the altitudes were observed for time, gives the longitude 117° 12′ 45″ W. when the distances were taken; the longitude by the chronometer at that time being 117° 30′ 15″ W.

EXAMPLE V.

April 7, 1866, in latitude 24° 29′ N., and longitude by account 39° 55′ E., suppose the following altitudes of the sun's lower limb were observed at about 5h. 12m. P. M., mean time at ship, with the corresponding times taken from a chronometer that was 14m. 44s *fast* for Greenwich mean time when the altitudes were observed, and was *gaining* daily 2s. 5; the height of the observer's eye being 18 feet, and the error of the sextant 1′ 30′ to be subtracted: required the mean time and error of the chronometer for the meridian of the ship, also the true longitude of the ship by the chronometer.

	Times by Chro. h. m. s.		Obs. alts. of ☉'s L. L. ° ′ ″		° ′ ″
	2 46 30		14 14 55	Obs. alt. ☉'s L. L.	13 44 00
	47 56		13 57 40	Dip of horizon......	− 4 4
	49 5		13 45 20		
	50 15		13 29 55		13 39 56
	51 9		13 19 40	Refrac.—Parallax..	− 3 43
	5) 244 55		5) 68 47 30		13 36 13
				Sun's semidiameter	+ 16 0
Mean of times by chro.	2 48 59	Mean of alts......	13 45 30		
Chronometer *fast*......	− 14 44	Index error	− 1 30	Sun's true altitude.	13 52 13
Mean time at Green. by chron. April 7	2 34 15	Obs. alt. ☉'s L. L.	13 44 00		

	° ′ ″		m. s.
Sun's declination (p. II. N. A.)......	6 51 3 N.	April 7.	
Hr. diff. +56″.33×2½h.=140″.82=	+ 2 21	Equation (p. I. N.A.)....	2 10.68 Apr. 7.
		Hr.-diff −0s.717×2¼h. =	− 1.79
Sun's declin. at Greenwich time ...	6 53 24 N.		
	90	Eq. at Greenwich time...	2 8.89
Sun's polar distance	83 6 36		

Sun's polar distance..........................	83 6½	...Co-secant......	0.00315
Ship's latitude	24 29	......Secant	0.04092
Sun's true altitude	13 52		
Sum	121 27½		
Half-sum	60 44	......Co-sine	9.68920
Remainder	46 52	......Sine	9.86318
	h. m. s.		
Apparent time at ship	5 11 27	......Log	9 59645 (XXXI.)
Equation of time...	+ 2 9		h. m. s.
Mean time at ship	5 13 36 April 7	....	5 13 36
Mean time at Greenwich	2 34 15 April 7.	Mean of times by chro.	2 48 59
Long. in time by chronometer	2 39 21=39°50′15″E.	Chro. *slow* of ship time.	2 24 37

In the evening, suppose the following observations were made of the moon and the star α Virginis (or Spica): required from thence the true longitude of the ship when the altitudes were taken, to ascertain the error of the chronometer for ship time.

	Times by Chron.	Alts. of Moon's L.L.	Alts. of * Spica.	Dist. ☾'s R.L. from *.	
	h. m. s.	° ′ ″	° ′ ″	° ′ ″	
	11 35 15	19 6 45	46 32 50	82 28 30	
	37 0	16 50	28 20	31 5	
	38 15	26 25	24 20	32 55	
	3) 110 30	3) 50 00	3) 85 30	3) 92 30	
Mean of times by chron...	11 36 50	19 16 40	46 28 30	82 30 50	
Chron. *gained* in interval...	– 0.9	– 1 40	– 1 30	+ 22	Errors
	11 36 49.1	19 15 0	46 27 00	82 31 12	
Chron. *slow* for merid. of ship, where the time altitudes were observed	2 24 37				
Mean time at that merid. when dist. was obs. ...	14 1 26.1	April 7.			

	h. m. s.
Mean of times by chronometer	11 36 50
Chron. *fast* for Greenwich time	– 14 44
	11 22 6
Chron. *gained* in 9 hours.........	– 0.9
Mean time at Green. by chron.	11 22 5.1

	′ ″
Moon's horizontal parallax at noon...	55 15.3
Moon's horizontal parallax at midn...	55 34.6
Difference of hor. par. in 12 hours...	19.3
Then, as 12h. : 19″.3 : : 11⅓h. :	+ 18.2
Moon's horizontal parallax at noon ...	55 15.3
Moon's hor. par. at Greenwich time..	55 33.5

	′ ″
Moon's semidiameter at noon	15 4.9
Moon's semidiameter at midnight.	15 10.2
Difference of semidiam. in 12 hours	5.3
Then, as 12h. : 5″.3 : : 11⅓h. :	+ 5.0
Moon's semidiameter at noon	15 4.9
Moon's semidiam at Green. time...	15 9.9

	° ′ ″
Obs. alt. * Spica	46 27 00
Dip of horizon...	– 4 4
Apparent altitude	46 22 56

	° ′ ″
Obs. alt. ☽'s L. L.	19 15 0
Dip of horizon	– 4 4
	19 10 56
☽'s semid. + 15 10 ☽'s aug. (VII) + 6	+ 15 16
Moon's app. alt. ...	19 26 12

	° ′ ″
Obs. distance R. L..	82 31 12
☽'s semid. – 15′ 10″ ☽'s aug. (VII) + 6	– 15 16
Apparent distance...	82 15 56

"Lyon's Method *improved*," *by* Coleman's *Lunar and Nautical Tables**.

	° ′ ″				
Moon's horizontal parallax	0 55 33.5	Pro. Log.	0 51052	....	0 51052
Star's apparent altitude...............	46 23 —	Co-secant	0. 14028		
Moon's apparent altitude	19 26 —	Co-secant		....	0 47793
Apparent distance	82 15 56	Sine	9. 99603	Tangent ...	0. 86711
First arc ....+	4 19 24	Pro. Log.	0. 64683		
Second arc ....+	5 2 31			.... Pro Log.	1. 85556
Third arc	+ 2 18				
True Distance—(*sub.* 10°.)=...	81 40 9				

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* These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

METHOD I.

By Krafft, *or Natural Versed Sines.*—Vide *Rules pp.* 266 *and* 267.

	°	′	″
Moon's app. alt. 19° 20′, and hor. par. 55′		49	3
Parts for 6′ of altitude ……………			+ 9
Parts for 34″ of parallax ……………			+ 32
Moon's correction …………………		49	44
Star's apparent altitude…………	46	22	56
Moon's apparent altitude ………	19	26	12
Sum of apparent altitudes (A) ……	65	49	8
Auxiliary arc …. …. (B) ……	60	9	47
Apparent distance …… (C) ……	82	15	56
Sum of A and B. ………………	125	58	55
Difference of A and B…………	5	39	21
Sum of B and C ………………	142	25	43
Difference of B and C.. …………	22	6	9
Sum of true zenith distances ……	113	22	2
True Distance………………	81	40	8

	°	′	″
(XXX.) ………………(XXX.*)	60	9	37
………………………………			+ 3
………………………………			+ 7
Parts for star's app. altitude 46°			+ 0
Auxiliary arc ……………	60	9	47
Sum of apparent altitudes ………	65	49	08
Moon's corr. (XXX.) + 49′ 44″ Star's corr. (XVIII.) − 0 54		+ 48	50
Sum of true altitudes ……………	66	37	58
	180		
Sum of true zenith distances ……	113	22	2

Versed..	87315	Parts for seconds ..	218
Versed..	04858	………………	9
Versed..	92467	………………	127
Versed..	73471	………………	17
Versed..	90614	………………	9
	380	Sum of the parts ..	380
Versed..	55106		

METHOD V.

By Norie's *Linear Tables.*—Vide *Rules, pp.* 269 *and* 270.

	°	′	″		
Apparent distance …………	82	15	56		
Correction for refraction ……	+	2	16		
Corrected distance …………	82	18	12	.. Sine …… 9.9961	Tangent .. 0.8690
Star's apparent altitude………	46	23	—	.. Co-secant.. 0.1403	
Moon's apparent altitude ……	19	26		.. Co-secant…………………	0.4779
Moon's horizontal parallax ….	0	55	33.5	Pro. Log. .. 0.5106…………	0.5106
First arc………………. ..	−	40	35	.. Pro. Log. .. 0.6470	
Second arc………………	+	2	30	…………………	Pro. Log. 1.8575
Correction for parallax …….	−	38	5	……………38′ gives 2″ } (XXXV.)	
Corrected distance …………	82	18	12	.. Parallax in alt..53 ″ 4 }	
	81	40	7	—	
Third correction …………		+	2	……… …………… 2″	
True Distance…………	81	40	9	—	
Distance at IX. hours by N. A..	80	26	37	………………	and Pro. Log. 0.2872
Difference ………………	1	13	32	…………………	Pro. Log. 0.3888

	h. m. s.		
Proportional part of time………………	2 22 27	…………	Pro. Log. 0.1016
Time of distance by the Naut. Alm. ……..	9		
Mean time at Greenwich ………………	11 22 27	April 7.	
Mean time at ship by the chronometer when the distances were observed …….	14 1 26.1	April 7.	
Long. in time at the place where the alts. were obs. to find the error of the chro.	2 38 59.1	= 30° 44′ 45″ East.	

When the time under the meridian of the ship cannot be found from altitudes taken with the distances, as is the case in the fourth and fifth Examples, the observer may, instead of finding the error of the watch or chronometer by altitudes taken before or after the distances, note the times by a chronometer at both observations, by which he will obtain the interval of time between those observations; this applied to the mean time at the ship when altitudes were observed for time, will shew the time under that meridian when the distances were taken; to which the longitude made during the interval, reduced to time, being applied, by adding or subtracting it, according to the ship's place, when the distances were observed, is east or west of its place when the altitudes for time were taken, the result will be the time at the ship corresponding to the place where the distances were observed: this compared with the time at Greenwich, will shew the ship's longitude at the time of taking the distances.

Suppose, for instance, that in the fifth Example, page 284, when altitudes of the sun were taken, about 5h. 12m. P.M. ship-time, the mean of the times shewn by a chronometer, gaining 2.5 seconds per day, was 2h. 48m. 59s., and the time by the same chronometer, where the distances were observed, 11h. 36m. 50s., the ship having, between the observations, made 48 miles of longitude to the eastward; we may proceed, as follows, to find the time at ship when the distances were taken, and thence the longitude at that time.

	h.	m.	s.	°	′	″
Mean time by chronometer when the sun's altitudes were observed	2	48	59			
Mean time by chronometer when the distances were observed	11	36	50			
Interval of time by chronometer	8	47	51			
Proportional part of rate or daily gain of chronometer during the above interval..		—	0.9			
Interval corrected for rate of chronometer	8	47	50.1			
Mean time at ship when sun's altitudes were observed	5	13	36			
Mean time at the above meridian when the distances were observed	14	1	26.1			
Change of longitude (in time) during the interval 48′ E.	+	3	12			
Mean time at ship, corresponding to the place where the distances were observed..	14	4	38.1			
Mean time at Greenwich when the distances were observed	11	22	27			
Longitude of ship when the distances were observed	2	42	11.1	=40	32	45E.

In the preceding Examples we have supposed altitudes to be taken at the same time with the distances; but circumstances may arise, such as an undefined horizon, or want of assistants, which may prevent the altitudes of one or both the objects being observed: in these cases it will be necessary to compute the altitudes corresponding to the distances.

For this purpose, take a set of altitudes when the object is at a proper distance from the meridian, either before or after the distances are observed, noting the times by a chronometer, or steady going watch, from which compute the apparent and mean time at ship; note also the times, by the same chronometer or watch, when the distances are observed; then, by means of the elapsed time, and the change of longitude during that interval, find the mean time at the place where the distances were observed, and thence the apparent time; corresponding to which, compute the altitudes by the following rules.

Rules. 1. Find the least meridian distance of the given object, which, if it be the sun, is the apparent time from the nearest noon; but if the object be the moon, a planet, or star, then add the sun's right ascension to the apparent time: their sum (deducting 24 hours, if it exceed that time) will be the right ascension of the meridian; the difference between which and the right ascension of the object, in time, will be its meridian distance; but should the remainder exceed 12 hours, subtract it from 24 hours, to give the least meridian distance.

2. Add together the log. rising of the meridian distance (XXIX.), the log. co-sine of the latitude (XXV.), and the log.co-sine of the declination.

3. Find the natural number corresponding to the sum of these three logarithms (XXIV.), rejecting the tens from the index, and add it to the natural versed sine (XXXVI.) of the difference of the declination and latitude, when they are of the same name—or of their sum, when of contrary names; the sum will be the natural versed sine of the true zenith distance, which subtracted from 90° will give the true altitude*.

4. If the object be the sun or a star, their correction from Table XVIII. added to the true altitude, will give the apparent altitude; if it be a planet, the refraction (IV.) is to be added, and the parallax in altitude (XLVIII.) is to be subtracted from the true altitude; but should the moon's apparent altitude be required, the correction taken from Table XXX., with the true altitude and horizontal parallax is to be subtracted from the true altitude†.

Note. The right ascension and declination of the sun, moon, or a planet, and the moon's horizontal parallax, are to be taken from the Nautical Almanac, and reduced to Greenwich time of observation. The right ascension and declination of a star are to be taken from Table XIII. and reduced to the given year and month.

Here follow two Examples, in which the apparent altitudes are found by the above Rules.

EXAMPLE VI.

March 11, 1861, in latitude 17° 18′ N., and longitude by account 11° 15′ W., at about 8h. 50m. A.M. apparent time at ship, suppose the observed altitude of the sun's lower limb to be 38° 27′ 45″; a chronometer (whose daily rate was 16 seconds *losing*) at the same time shewing 9h. 48m. 10s., the observer's eye being 18 feet, and the error of the sextant + 2′ 30″.

Again, suppose on the same forenoon, when the above chronometer shewed 11h. 17m. 43s., the distance between the sun and moon was observed to be 69° 33′ 00″, the ship having (since the first observation) made 15 miles of latitude to the Southward, and 45 miles of longitude to the Eastward; the height of the eye, and index error as before: required the true longitude of the ship, at the time the distance was observed.

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* In this operation the log. co-sines are to be taken out to five places of decimal figures only, and the natural versed sines to the *first five decimal figures* in the Table.

† The result of the above will be the *approximate* apparent altitude; and if greater accuracy be required, the moon's correction should be again taken out with the approximate apparent altitude, and applied to the true altitude, instead of the former correction.

	h. m.	
App. time at ship 8h. 50m. A.M. 11th =	20 50	March 10
Long. by acc. 11° 15′ in time ..	+ 45	W.
App. time at Greenwich by acc.	21 35	
Equation of time	+ 10	
Mean time at Greenwich by acc.	21 45	March 10

	h. m. s.
Time by chron. when the sun's altitude was observed	21 48 10
Ditto when distance was observed ..	23 17 43
Interval of time between the obs. ..	1 29 33
Pro. part of rate during the interval .	+ 1
Interval corr. for the rate of chron...	1 29 34

	° ′ ″
Observed alt. of sun's lower limb....	38 27 45
Index error of the sextant.........	+ 2 30
	38 30 15
Corr. from Table IX., + 10′.8 = ...	+ 10 48
Sun's true altitude	38 41 3

	° ′ ″
Sun's declin. March 10 (p. II., N.A.)	4 4 24 S.
Hour. diff. 58″.76 × 21¾h. = ...	− 21 18
Sun's declin. at Greenwich time ..	3 43 6 S.
	90
Sun's polar distance	93 43 6

	° ′		
Sun's polar distance	93 43	Co-secant........	0.00091
Ship's latitude	17 18	Secant	0.02011
Sun's true altitude........	38 41		
Sum	149 42		
Half-sum................	74 51	Co-sine	9.41722
Remainder	36 10	Sine	9.77095
	h. m. s.		
Time from noon	3 9 48	Log.	9.20919 (XXXI.)
	24		
Apparent time at ship....	20 50 12	March 10.	
Equation of time	+ 10 14		
Mean time at ship	21 0 26		
Interval between the observations ..	1 29 34		
Mean time at ship when the distance was observed.........	22 30 00	March 10.	
Change of long. 45′ in time	+ 3 0		
True mean time when dist. was observed	22 33 0	March 10.	

	m. s.
Equation by N.A., March 10	10 28.56
Hour. diff. − 0s.66 × 21¾ =......	− 14.35
Equation at Greenwich time......	10 14.21

To find the Sun's apparent Altitude when the distance was observed.

	° ′
Lat. when the sun's alt. was observed	17 18 N.
Diff. of lat. made during the interval	− 15 S.
Latitude when the distance was obs..	17 3 N.

	° ′
Long. by acc. when ☉'s alt. was obs.	11 15 W.
Diff. of long. made during the interval	− 45 E.
Long. by acct. when the dist. was obs.	10 30 W.

	h. m. s.
Mean time at the ship when the distance was observed	22 33 0
Long. of ship 10° 30′ in time (XIX.)	+ 42 0 W.
Mean time at Greenwich	23 15 0

	° ′ ″
Sun's declin. Mar. 10 (p. II. N.A.)	4 4 24 S.
Hour. diff. − 58″.76 × 23h. 15m. =	− 22 46
Sun's declin. at Greenwich time..	3 41 38 S.

	h. m. s.
Mean time at the ship when the distance was observed	22 33 0
Equation at Greenwich time	− 10 13
Apparent time at ship	22 22 47
	24
Time from noon	1 37 13

	m. s.
Equation of time, Mar. 10, by N.A..	10 28.56
Hour. diff. 0s. 66 × 23h. 15m. = ...	− 15.34
Equation at Greenwich time........	10 13.22

	h. m. s.			
Time from noon	1 37 13	....	Rising......	3.94756
Ship's latitude	17° 3′ N.	....	Co-sine	9.98048
Sun's declination	3 41½ S.	....	Co-sine	9.99910
		Natural number 8456	Log.........	3.92714
Sum (*Lat & Dec. diff. names*)	20 44½....	Versed 06481		
Zenith distance	31°43′11″	Versed 14937		
	90			
Sun's true altitude	58 16 49			
Refraction—par. (XVIII.) ..	+ 0 30			
Sun's apparent altitude	58 17 19			

To find the Moon's Apparent altitude when the Distance was observed.

	h. m. s.			° ′ ″	
☽'s R.A. at 23h. Mar. 10,	18 46 42	(p. VI. N.A.)	☽'s dec. at 23h. Mar. 10,	17 44 37 S.	(p. VI. N.A.)
☽'s R.A. at 0h. Mar. 11,	18 48 54		☽'s dec. at 0h. Mar. 11,	17 41 59 S.	
Variation in 1 hour..	2 12	Log. 1.4357	Variation in 1 hour..	2 38	Log.. 1.3576
Time after 23 hours..	15m. 0s.	Log. 0.6021	Time after 23 hours..	15m. 0s.	Log.. 0.6021
	h. m. s.			° ′ ″	
Variation in 15m. 0s.	+ 0 33	Log. 2.0378	Variation in 15m. 0s.	— 0 40	Log.. 1.9597
☽'s R.A, at 23h. Mar. 10,	18 46 42		☽'s dec. at 23m. Mar. 10	17 44 37 S.	
☽'s R. A. at Green. time	18 47 15		☽'s dec. at Green. time	17 43 57 S.	

Moon's semidiam. at Greenwich time 15′ 18″ Moon's hor. par. at Greenwich time.. 56′ 2″.0

	h. m. s.
Sun's right ascension, March 10, (p. II. N. A.)	23 22 13
Hourly diff. + 9s.2 × 23h. 15m. = 213s.9 =	+ 3 34
Sun's right ascension at Greenwich time ..	23 25 47

	h. m. s.			
Apparent time at ship	22 22 47			
Sun's right ascension	23 25 47			
Right ascension of meridian..	45 48 34			
	24			
Least right ascen. of meridian	21 48 34			
Moon's right ascension	18 47 15			
Moon's meridian distance....	3 1 19	....	Rising......	4.47271
Ship's latitude	17° 3′ N.	....	Co-sine	9.98048
Moon's declin. at Gr. time ..	17 44 S.	....	Co-sine	9.97886
		Natural Number 27043	Log.	4.43205
Sum (*Lat. & Dec. contʸ. name*)	34 47	Versed 17869		
Zenith distance	56° 34′ 21″	Versed 44912		
	90			
Moon's true altitude	33 25 39			
Corr. from Table XXX.......	— 45 42			
Moon's apparent altitude....	32 39 57			

To find the Apparent Distance.

	° ′ ″
Observed distance by the sextant	69 33 00
Index error to be added...............	+ 2 30
Distance corrected for index error	69 35 30
Sun's semidiameter (p. II. N. A.)	+ 16 8
Moon's semidiameter at Greenwich time	+ 15 18
Moon's augmentation (Table VII.)	+ 9
Apparent distance of sun and moon	70 7 5

Note.—Or the proportional part of change in Moon's R. A. and Declin. may be found thus:—
Var. of ☽'s R.A. in 1 *h.* is 2m.12s.—Then say : 1h. : 2m.12s. : : 15m.0s. : 0m.33s. Corr. for R.A.
Var. of ☽'s Dec. in 1 *minute* is 2″.60 × 15m.0s. = 0′39″ Corr. for Declin.—Vide *Note* p. 187.

To find the "TRUE DISTANCE," *by* COLEMAN'S *Lunar and Nautical Tables.**

	°	′	″			
Moon's horizontal parallax	0	56	2	Pro. Log. 0.50683		0.50683
Sun's apparent altitude	58	17	—	Co-secant 0.07025		
Moon's apparent altitude	32	40	—	Co-secant		0.26781
Apparent distance	70	7	5	Sine 9.97331	Tangent	0.44169
First arc	+ 4	9	19	Pro. Log. 0.55039		
Second arc	+ 5	10	56		Pro. Log.	1.21633
Third arc	+	1	32			
TRUE DISTANCE (*Sub.* 10°)=	69	28	52			

METHOD I.

By KRAFFT, *or Natural Versed Sines.*—Vide *Rules pp.* 266 *and* 267.

	′ ″		° ′ ″
Moon's app. alt. 32° 40′, and hor. par. 56′	45 30	(XXX.) ....(XXX.*)	60 16 31
Parts for 0′ of altitude	+ 10		+ 0
Parts for 2″ of parallax	+ 2		+ 1
		Parts for sun's altitude 58°	+ 4
Moon's correction	45 42	Auxiliary arc	60 16 36

	° ′ ″		
		Sum of apparent altitudes	90 57 16
Sun's apparent altitude	58 17 19	Moon's corr. (XXX.) + 45′ 42″ Sun's corr. (XVIII.) − 0 30	+ 45 12
Moon's apparent altitude	32 39 57		
Sum of altitudes (A)	90 57 16	Sum of true altitudes	91 42 28
Auxiliary arc (B)	60 16 36		180
Apparent distance (C)	70 7 5	Sum of true zenith distances	88 17 32

Sum of A and B	151 13 52	Versed.. 76447	Parts for seconds	122
Difference of A and B	30 40 40	Versed.. 39851		99
Sum of B and C	130 23 41	Versed.. 47898		152
Difference of B and C	9 50 29	Versed.. 14691		23
Sum of true zenith distances	88 17 32	Versed.. 70043		155
	° ′ ″	551	Sum of the parts	551
TRUE DISTANCE	69 28 51	Versed.. 49481		

METHOD V.

To find the True Distance by NORIE'S *Linear Tables, and thence the Longitude.*

	° ′ ″		
Apparent distance	70 7 5		
Correction for refraction	+ 1 31		
Corrected distance	70 8 36	Sine ...... 9.9734 Tangent	0.4423
Sun's apparent altitude	58 17 —	Co-secant.. 0.0702	
Moon's apparent altitude	32 40 —	Co-secant	0.2678
Moon's horizontal parallax	0 56 2	Pro. Log. .. 0.5068	0.5068
First arc	− 50 41	Pro. Log. .. 0.5504	
Second arc	+ 10 55	Pro. Log.	1.2169
Correction for parallax	− 39 46	40′ gives 5″ } (XXXV.)	
Corrected distance	70 8 36	Parallax in alt. 47 ″ 7 }	
	69 28 50		
Third correction	+ 2	2″	
TRUE DISTANCE	69 28 52		
Distance at XXI. hours by N. A.	70 34 22	and Pro. Log.	0.3147
Difference	1 5 30	Pro. Log.	0.4390

	h. m. s.		
Proportional part of time	2 15 12	Pro. Log.	0.1243
Time of distance by the Naut. Alm.	21		
Mean time at Greenwich	23 15 12	March 10.	
Mean time at ship	22 33 00	March 10.	
Longitude in time	0 42 12	= 10° 33′ 00″ West.	

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* These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

EXAMPLE VII.

June 24, 1866, about 1h. 15m. A. M., (*civil time*), apparent time at ship, in latitude 27° 15′ N., and longitude by account 131° 30′ E., suppose the distance of the moon's *nearest limb* from the Star α AQUILÆ or ALTAIR was observed to be 78° 11′ 50″:—and at 10m. 20s. after (as measured by a good watch,) the ship being in nearly the same place, the observed altitude of the Star MARCAB was 39° 15′ 30″ (*Eastward of the meridian*), the height of the observer's eye, being 24 feet, and the error of the sextant 1′ 45″ to subtract: required the true longitude of the ship when the distance was taken.

	h. m.		h. m. s.
Apparent time at ship when the distance was observed	13 15 June 23	Sun's R. A. June 23 (p. II N. A...	6 7 32
Interval of time by watch......	+ 10	Hr diff. +10s.39×4h.41m. = 48s.48 =	+ 0 48
		Sun's R. A. at Green. mean time...	6 8 20
Apparent time at ship when the star's alt. was observed	13 25		° ′ ″
Long. by acc. 131° 30′ in time	8 46 East.	Star Marcab's observed altitude ...	39 15 30
		Index error of the sextant...........	− 1 45
App. time at Green. when the star's alt. was observed	4 39		39 13 45
Equation of time	+ 2	Correction from Table XV. − 5′.8 =	− 5 48
Mean time at Green. by acc....	4 41 June 23	Star Marcab's true altitude	39 7 57

	h. m. s.		° ′ ″
Star's right ascension, Jan. 1860...	22 57 47	Star's declination, January 1860	14 27 10 N.
Ann. var. +2s.98 × 6½ = 19s 37 =	+ 19	An.var. +19 .30×6½ = 125″.45 =	+ 2 5
Star's right ascension, June 1866...	22 58 06	Star's declination, for June 1866	14 29 15 N.
			90
	h. m s		
Or Marcab's R. A. p. 383 of N.A...	22 58 7	Star Marcab's polar distance ...	75 30 45
Or Marcab's decl. p. 383 of N.A,...	14° 29′ 14″ N.		

	° ′		
Star's polar distance	75 31	......Co-secant ...	0.01403
Ship's latitude	27 15	......Secant	0.05109
Star's true altitude	39 8		
Sum	141 54		
Half-sum	70 57	......Co-sine	9.51374
Remainder	31 49	......Sine	9.72198

	h. m. s.		m. s.
Star's distance from the meridian...	3 32 28 E.	Log	9.30084 (XXXI.)
Star Marcab's right ascension	22 58 7		
Right ascension of meridian	19 25 39		
Sun's right ascension	6 8 20	Equation by N. A., June 23.........	1 49 34
App. time at ship when the star Marcab's altitude was observed	13 17 19	Hourly diff. +0s.54 × 4h. 41m. =	+ 2.52
Equation at Greenw. mean time ...	+ 1 52	Equation at Greenwich time.........	1 51.86
Mean time at ship when the star Marcab's altitude was observed	13 19 11		
Interval of time by the watch	− 10 20		
Mean time at ship when the distance was observed...............	13 8 51 June 23.		

NOTE.—The star's right ascension and declination, may always be taken from the Nautical Almanac, (as shewn above) answering to the given day, *or the nearest one to it*; by which it would save the time and trouble of working the above computation from Table XIII.

To find the Apparent Altitude of the Star AQUILÆ, *or* ALTAIR, *when the Distance was observed.*

	h. m. s.		h. m. s.
Mean time at ship, when the distance was observed ..	13 8 51 June 23	....	13 8 51 June 23
Long. by acct. 131°30′ in time	8 46 0 E.	Eq. at 4h. 23m. Green. time	— 1 52
Estimated time at Greenwich	4 22 51 June 23	App. time at ship when the distance was observed ..	13 6 59 June 23
	m. s.		h. m. s.
Equation, June 23, from p. II. N.A..	1 49.32	Star's right ascension, Jan. 1860 ..	19 43 57
Hourly diff. + 0s.54 × 4h. 23m.....	+ 2.32	Ann. var. + 2s.93 × 6½ = 19s.04 =	+ 19
Equation at Greenwich time........	1 51.66	Star's right ascension, June, 1866..	19 44 16*
	h. m. s.		
Sun's right ascen. from p. II. N.A..	6 7 32	June 23.	
Hourly diff. + 10s.39 × 4h. 23m. =	+ 0 45		° ′ ″
Sun's right ascen. at Greenwich time	6 8 17	Star's declination for Jan., 1860..	8 30 5N.
Apparent time when distance was obs.	13 6 59	Ann.var. + 9″.18 × 6½ = 59″.67 =	+ 1 0
Right ascension of meridian........	19 15 16	Star's declination for June, 1866	8 31 5N.†
Star's right ascension, June, 1866 ..	19 44 16		
Star's distance from the meridian ..	29 0	.... Rising....	2.90282
Ship's latitude....................	27° 15′ N.	.... Co-sine ..	9.94891
Star's declination, June, 1866	8 31 N.	.... Co-sine ..	9.99518
		Nat. number.... 703 .. Log.	2.84691
DIFF. *(Lat. and Dec. same names)*	18 44 ..	Versed 05298	
Star's true zenith distance	19° 57′ 00″	Versed 06001	
	90		
Star's true altitude................	70 3 00	*Or, the Star's R.A. & Dee. may be taken from N.A.*	
Refraction (IV. or XVIII.)	+ 21		h. m. s.
Star's apparent altitude............	70 3 21	* *Right ascen. of Aquilæ* (p.375, *N.A.*)	19 44 17
		† *Declin. of Aquilæ*, (p.375, *N.A.*)	8° 31′ 12″ N.

To find the Moon's apparent Altitude when the distance was observed.

	h. m. s.			° ′ ″	
☽'s R.A. at 4h. June 23	14 42 52	(p.VII.N.A.)	☽'s dec. at 4h. June 23	12 50 14 S.	(p.VII.N.A.)
☽'s R.A. at 5h. June 23	14 44 50		☽'s dec. at 5h. June 23	12 57 3 S.	
Variation R.A. in 1 hour	1 58	Log. 1.4844	Variation dec. in 1h.	6 49	Log... 0.9146
Time after 4 hours..	22m. 51s.	Log. 0.4193	Time after 4 hours..	22m. 51s.	Log... 0.4193
	h. m. s.			° ′ ″	
Variation in 22m. 51s.	+ 0 45	Log. 1.9037	Variation in 22m. 51s.	+ 2 36	Log... 1.3639
☽'s R.A. at 4h. June 23,	14 42 52		☽'s dec at 4h. June 23,	12 50 14 S.	
☽'s R.A. at Green. time	14 43 37		☽'s dec. at Green. time	12 52 50 S.	
	h. m. s.		Moon's hor. par. at Greenwich time ..		60′ 50″
Right ascension of meridian (as above)	19 15 16				
Moon's right ascen. at Greenwich time	14 43 37				
Moon's distance from meridian	4 31 39	....	Rising		4.79517
Ship's latitude....................	27° 15′ N.	....	Co-sine....		9.94891
Moon's declin. at Greenwich time ..	12 53 S.	....	Co-sine....		9.98893
			Natural number 54077.. Log.		4.73301
SUM *(Lat. and Dec. of diff. names)*	40 8	....	Versed	23545	
Moon's true zenith distance........	77° 5′ 54″		Versed	77622	
	90				
Moon's true altitude	12 54 6				
Moon's correction from Table XXX.	— 48 32				
Moon's apparent altitude	12 5 34				

To find the Apparent Distance.

	° ′ ″
Observed distance by sextant (N. L.)	78 11 50
Index error to subtract	— 1 45
Obs. distance corrected for error....	78 10 5
Moon's semidiam. at Greenwich time	+ 14 46
Moon's augment. from Table VII. ..	+ 3
Apparent distance	78 24 54

To find the "TRUE DISTANCE," *by* COLEMAN'S *Lunar and Nautical Tables.*[*]

	°	′	″				
Moon's horizontal parallax	0	54	6	Pro. Log.	0.52208	....	0.52208
Star's apparent altitude	70	3	21	Co-secant	0.02686		
Moon's apparent altitude	12	5	34	Co-secant		....	0.67887
Apparent distance	78	24	54	Sine	9.99106	Tangent	0.68832
First arc........................+	4	8	5	Pro. Log.	0.54000		
Second arc.......................+	5	2	19	....		Pro. Log......	1.88927
Third arc	+	4	8				
TRUE DISTANCE (*Sub.* 10°)=	77	39	26				

METHOD I.

By KRAFFT, *or Natural Versed Sines.*—Vide *Rules pp.* 266 *and* 267.

	°	′	″		°	′	″
Moon's app. alt. 12° 00′, and hor. par. 54′..		48	26	(XXX.)....................(XXX.*)	60	5	35
Parts for 6′ of altitude		+	1	....		+	3
Parts for 6″ of parallax		+	6	....		+	1
				Star's apparent altitude 70°.. .		+	0
Moon's correction		48	33	Auxiliary arc	60	5	39
	°	′	″	Sum of apparent altitudes	82	8	55
Star's apparent altitude............	70	3	21	Moon's corr. (XXX.) + 48′ 33″ } ..	+	48	12
Moon's apparent altitude	12	5	34	Star's corr. (XVIII.) − 21 }			
Sum of apparent altitudes (A)	82	8	55	Sum of true altitudes	82	57	7
Auxiliary arc .... (B)	60	5	39		180		
Apparent distance ...... (C)	78	24	54	Sum of true zenith distances	97	2	53

	°	′	″				
Sum of A and B.	142	14	34	Versed..	90512	Parts for seconds ..	101
Difference of A and B.............	22	3	16	Versed..	73143	....	29
Sum of B and C	138	30	33	Versed..	48956	....	107
Difference of B and C..	18	19	15	Versed..	50666	....	23
Sum of true zenith distances	97	2	53	Versed..	22147	....	255
	°	′	″		515	Sum of the parts ..	515
TRUE DISTANCE..................	77	39	26	Versed..	86239		

METHOD V.

To find the True Distance, and thence the Longitude by NORIE'S *Linear Tables.*

	°	′	″				
Apparent distance	78	24	54				
Correction for refraction	+	4	6				
Corrected distance	78	29	00	..Sine	9.9912	Tangent ..	0.6909
Star's apparent altitude........	70	3	21	..Co-secant..	0.0269		
Moon's apparent altitude	12	5	34	..Co-secant....................			0.6789
Moon's horizontal parallax		54	6	..Pro. Log...	0.5221	....	0.5221
First arc...................... ..	−	51	53	..Pro. Log...	0.5402		
Second arc	+	2	19	....		Pro. Log.	1.8919
Correction for parallax	−	49	31	................50′ gives 5″ } (XXXV.)			
Corrected distance	78	29	00	..Parallax in alt. 53 〃 5 }			
	77	39	26	—			
Third correction		+	0	.... 0″			
TRUE DISTANCE..............	77	39	26	—			
Distance at III. hours by N. A..	78	16	27	....		and Pro. Log.	0.3510
Difference		37	1	....		Pro. Log.	0.6869

	h.	m.	s.			
Proportional part of time..................	1	23	3	....	Pro. Log.	0.3359
Time of distance from Naut. Alm.	3					
Mean time at Greenwich by lunar..........	4	23	3	June 23.		
Mean time at ship when distance was obs. ..	13	8	51	June 23.		
Longitude in time, when distance was obs..	8	45	48	= 131° 27′ East.		

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[*] These Tables may be obtained of the Author or Publisher, at 157, Leadenhall Street.

EXAMPLE VIII.

January 10, 1866, at about 11h. 9m. A.M., apparent time at ship, in latitude 17° 30′ S., and longitude by account 94° 45′ E., the following observations were taken between the sun and moon, with the corresponding times by a chronometer.*

On the same day, when the same chronometer shewed 7h. 48m. 22s. mean time, the altitude of the sun's lower limb was 39° 17′ 45″, the ship having (since the first observations were taken) run 30 miles of longitude to the eastward, but remained in the same latitude: required the true longitude of the ship when the distances were observed, the height of the observer's eye being 18 feet, and the error of the sextant 1′ 15″ to subtract.

	Times by Chron. h. m. s.		° ′ ″	
	4 59 24	Altitude of the sun's lower limb........	73 54 30	
	5 2 31	Altitude of the moon's upper limb......	29 25 10	
Mean of Times 5h. 7m. 12s.	5 4 56	Distance of the nearest limbs..........	76 14 33	Mean of distances 76° 16′ 10″
	5 7 30	Distance of the nearest limbs..........	76 16 30	
	5 9 10	Distance of the nearest limbs..........	76 17 27	
	5 11 3	Altitude of the moon's upper limb......	26 51 20	
	5 13 46	Altitude of the sun's lower limb	76 43 10	

To reduce the Altitude of the Sun to the Time corresponding to the Mean Distance.

	h. m. s.		h. m. s.		° ′ ″
Time of sun's first alt..	4 59 24	Time of sun's first alt....	4 59 24	Sun's first alt..	73 54 30
Time of sun's last alt..	5 13 46	Mean of times by chron..	5 7 12	Sun's last alt..	76 43 10
Difference	14 22	Difference	7 48	Difference	2 48 40

As	14m. 22s..............	Pro. Log.	(Arith. Comp.)† ..	8.9021
Is to	7m. 48s..............	Pro. Log.	....	1.3632
So is	2° 48′ 40″...........	Pro. Log.	....	0.0282
To *increase* of sun's altitude ....+	1° 31′ 35″	Pro. Log.	....	0.2935
Sun's first observed altitude......	73 54 30			
Sun's altitude at mean of times ..	75 26 5			

To reduce the Altitude of the Moon to the Time corresponding to the Mean Distance.

	h. m. s.		h. m. s.		° ′ ″
Time of moon's first alt.	5 2 31	Time of moon's first alt..	5 2 31	Moon's first alt.	29 25 10
Time of moon's last alt.	5 11 3	Mean of times by chron..	5 7 12	Moon's last alt.	26 51 20
Difference	8 32	Difference	4 41	Difference	2 33 50

As	8m. 32s.	Pro. Log.	(Arith. Comp.)†	8.6758
Is to	4m. 41s.	Pro. Log.	....	1.5847
So is	2° 33′ 50″...........	Pro. Log.	....	0.0682
To *decrease* of moon's altitude .. —	1° 24′ 27″	Pro. Log.	....	0.3287
Moon's first observed altitude..	29 25 10			
Moon's altitude at mean of times	28 0 43			

Hence we obtain the following set of observations, *viz.*

Mean of times by Chron.	Dist. nearest L. of ☉ & ☾.	Alt. of ☉ L. L.	Alt. of ☽'s U. L.
5h. 7m. 12s.	76° 16′ 10″	75° 26′ 5″	28° 0′ 43″

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* For the Method of taking the altitudes and distances *without assistants*, see page 229—See also explanation of Table XXXIX.

† The Arithmetical Complement is found by subtracting the Proportional Log. from 10.0000.

To find the True Distance, and thence the Mean Time at Greenwich.

	h.	m.	
Time at ship 11h. 9m. A.M. Jan. 10	23	9	
Long. by acc. 94°45′ in time (XIX)	6	19	E.
App. time at Greenwich by acc..	16	50	Jan. 9.

	°	′	″
Observed distance, sun and moon....	76	16	10
Index error, to subtract	−	1	15
	76	14	55
Sun's semidiameter (p. II. N. A.) ..	+	16	18
Moon's semidiam. at Greenwich time.	+	14	48
Moon's augment. from Table VII....		+	8
Apparent distance..................	76	46	9

	°	′	″
Obs. alt of the sun's lower limb....	75	26	5
Dip of the horizon................	−	4	4
	75	22	1
Sun's semidiameter by N. A.	+	16	18
Sun's apparent altitude	75	38	19

	°	′	″
Obs. alt. of the moon's upper limb..	28	0	43
Dip of the horizon................	−	4	4
	27	56	39
Moon's semidiameter .. − 14′48″ Moon's augmentation (VII.) + 8	−	14	56
Moon's apparent altitude..........	27	41	43

To find the TRUE DISTANCE, *by* COLEMAN'S *Lunar and Nautical Tables.**

	°	′	″				
Moon's horizontal parallax	0	54	14	Pro. Log..	0.52101	....	0.52101
Sun's apparent altitude	75	38	0	Co-secant	0.01380		
Moon's apparent altitude	27	42	0	Co-secant	....	...	0 33270
Apparent distance	76	46	9	Sine	9.98831	.... Tangent	0.62863
First arc.......................+	4	6	2	Pro. Log..	0.52312		
Second arc ....+	5	5	56	....		Pro. Log.	1.48234
Third arc ....+		1	57				
TRUE DISTANCE (*Sub.* 10° =) ..	76	0	4				

To find the TRUE DISTANCE, *and thence the Longitude, by* NORIE'S *Linear Tables.*

	°	′	″				
Apparent distance	76	46	9				
Correction for refraction....	+	1	58				
Corrected distance	76	48	7	Sine......	9.9884	....Tangent....	0.6298
Sun's apparent altitude	75	38	0..	Co-secant..	0.0138		
Moon's apparent altitude ..	27	42	0..	Co-secant....	....	..	0.3327
Moon's horizontal parallax..		54	14..	Pro. Log..	0.5210	....	0.5210
First arc..................	−	53	58..	Pro. Log..	0.5232		
Second arc	+	5	55..	....		Pro. Log. ..	1.4835
Correction for parallax	−	48	3.	................48′ gives 5″ } (XXXV.)			
Corrected distance	76	48	7..	Parallax in alt...48 〃 5			
	76	0	4	—			
Third correction		+	0.	.... 0″			
TRUE DISTANCE	76	0	4	—			
Dist. at XV. hours N. A....	76	48	45.	....		and Pro. Log.	0.3483
Difference		48	41.	....		Pro. Log.	0.5679

	h.	m.	s.		
Proportional part of time	1	48	34	........................Pro. Log.	0.2196
Time of distance by Naut. Alm.	15				
Mean time at Greenwich	16	48	34	Jan. 9.	

To find the Mean Time at Ship, and thence the Longitude.

	h.	m.	s.	
Time by chron. when the distance was observed.	5	7	12	Jan. 9.
Do. when time alt. was obs.	7	48	22	
Interval between the obs ..	2	41	10	
Time at Green. when the distance was taken....	16	48	34	
Do. when alt. was obs.....	19	29	44	Jan. 9.

		°	′	″	
Sun's dec. (p. II. N. A.) Jan. 9..	−	22	5	46	S.
Corr. for 12h. 0m. 4′ 19″ Corr. for 7h. 30m. 2 40 } (XXI.) ..	−		6	59	
Sun's declin. at Greenwich time....		21	58	47	S.
		90			
Sun's polar distance		68	1	13	

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* These Tables may be obtained of the Author, or Publisher, at 157, Leadenhall Street.

	m. s.
Eq. of time by NA.	7 25.56
Hour. diff. + 1s.03 × 19½h. = 20.08 =	+ 20.08
Eq. at Green. time	7 45.64

	° ′ ″		
Obs. alt. of sun's L.L....	65 25 10		
Index error to subtract..	− 1 15		
	65 23 55		
Corr. Table IX. + 11′.7 =	+ 11 42		
Sun's true altitude	65 35 37		
Sun's polar distance......	68 1	..Co-secant	0.03278
Ship's latitude	17 30	..Secant ...	0.02058
Sum	151 6½		
Half-sum	75 33	..Co-sine...	9.39713
Remainder	9 57½	..Sine......	9.23788
	h. m. s.		
App. time at ship when the time altitude was observed	1 42 6	..Log......	8.68837 (XXXI.)
Equation at Greenwich mean time	+ 7 46		
Mean time at ship when the time altitude was observed	1 49 52	Jan. 10.	
	24		
Ditto .... Ditto	25 49 52	Jan. 9.	
Mean time at Green. when the time altitude was obs....	19 29 44	Jan 9.	
		° ′ ″	
Longitude in time when the time altitude was taken...	6 20 8	= 95 2 00 E.	
Difference of Longitude made during the interval.........		− 30 0 E.	
Longitude of the ship when the distance was observed ...		94 32 00 E.	

EXAMPLES FOR EXERCISE.

1. May 8, 1866, in latitude 34° 31′ N., and longitude by account 50° 10′ W., at about 7h. 56m. A. M., mean time at ship, suppose the distance between the sun and moon was observed to be 83° 1′ 10″; at the same time the altitude of the moon's upper limb was 41° 42′ 20″; and the altitude of the sun's lower limb 33° 45′ 40″; the height of the observer's eye being 18 feet, and the instruments adjusted: required the true longitude of the ship.

ANSWER. The true distance 83° 6′ 36″;* mean time at Greenwich, 23h. 16m. 2s. past noon of May 7; mean time at ship 19h. 55m. 36s.; and the true longitude of the ship 50° 6′ 30″ West

2. June 25, 1866, P. M. at ship, in latitude 18° 36′ S., and longitude by account 47° 50′ W., when a chronometer which was 3m. 40s. *fast* for Greenwich mean time, shewed 3h. 8m. 40s. (being June 26, A. M. at Greenwich), suppose the distance of the moon's *remote limb* from the star FOMALHAUT, was observed to be 83° 15′ 15″; the altitude of the moon's lower limb 69° 45′ 30″; and the altitude of the star (*Eastward of the meridian*) 25° 55′ 10″; the height of the observer's eye being 18 feet, with the instruments adjusted: required the true longitude of the ship, by the lunar observation and chronometer.

ANSWER. The true distance 82° 44′ 50″; the mean time at Greenwich, 15h. 4m. 34s.; the mean time at ship 11h. 52m. 37s., on June 25; the longitude of the ship by the lunar observation 47° 59′ 15″ W., and by the chronometer 48° 5′ 45″ West.

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* NOTE.—All the true distances and longitudes in the Examples for Exercise, are computed by COLEMAN's Lunar and Nautical Tables.—Edition 1857.

3. July 2, 1866, A. M. at ship (*civil time*), in latitude 40° 11′ S., and longitude by account 166° 28′ E., when a chronometer shewed 5h. 20m. 5s. P.M., being 6m. 28s., *fast* of Greenwich mean time; suppose the angular distance of the moon's *nearest limb*, from the centre of the Planet Mars was observed to be 82° 15′ 53″; at the same time the altitude of the moon's lower limb was 54° 45′ 40″; and the altitude of the planet's centre being 13° 30′ 30″ (*Eastward of the meridian*); the height of the observer's eye 22 feet, and the index error of the sextant which measured the distance 1′ 10″ to add: required the mean time at the meridian of the ship by the *planet's altitude*, and thence the longitude when the distance was observed, by the lunar observation and the chronometer.

Answer. The true distance 82° 28′ 53″; the mean time at Greenwich 5h. 14m. 7s.; the mean time at ship 16h. 19m. 3s.; the longitude by the lunar observation 166° 14′ 00″ E., and by the chronometer 166° 21′ 30″ E.

4. February 22, 1866, P. M., mean time at ship, in latitude 42° 10′ N., and longitude by account 125° 36′ W., when a chronometer which was 2m. 14s. *slow* for mean time at Greenwich, shewed 4h. 11m. 17s. A.M. 23d, suppose the angular distance between the moon's *remote limb* and the star Regulus (α Leonis) to be 71° 32′ 40″; at the same time the altitude of the moon's upper limb 62° 31′ 30″: with that of the star 30° 59′ 45″ (*Eastward* of the meridian); the height of the observer's eye 24 feet, with the following index errors to be applied, *viz.*, to the observed distance *add* 0′ 20″; from the moon's altitude *subtract* 1′ 35″; and to the star's altitude *add* 1′ 10″: required the mean time at ship, *when the altitude of Regulus was taken;* also, the true longitude of the ship by the lunar observation and chronometer.

Answer. The true distance 71° 4′ 13″; the mean time at Greenwich 16h. 13m 52s.; the mean time at ship by the *star's altitude* 7h. 51m. 58s; the longitude by the lunar observation 125° 28′ 30″ W., and by chronometer 125° 23′ 15″ W.

5. August 4, 1866, A. M., at ship (*civil time*), in latitude 30° 30′ N., and longitude by account 25° 40′ W., when a chronometer, which was *fast* of mean time at Greenwich 2m. 10s., shewed 9h. 21m. 7s., being A. M., the altitude of the sun's lower limb was 27° 45′ 30″; and at A. M., *ship time*, when the same chronometer shewed 1h. 15m. 17s., P. M., suppose the distance between the sun and moon was observed to be 80° 28′ 15″; the altitude of the sun's lower limb at the same time 74° 50′ 50″; and the altitude of the moon's upper limb 18° 16′ 10″; the height of the observer's eye 18 feet, with the instruments all properly adjusted: required the longitude of the ship by the lunar observation and chronometer, *when the sun's altitude was taken for time.*

Answer. The mean time at the meridian of the ship when the sun's altitude was observed for time, 19h. 36m. 38s., August 3, consequently the chronometer was at that time *fast* of the ship's meridian by 1h. 44m. 29s.: the true distance 80° 8′ 9″; and the corresponding Greenwich mean time 25h. 12m. 56s. August 3: the mean time at ship 23h. 30m. 48s. past noon, August 3: and hence the longitude by the lunar observation 25° 32′ 0″ W., and by the chronometer 25° 34′ 45″ W.

6. December 25, 1866, A.M., at ship (*civil time*), in latitude 16° 40′ S., and longitude by account 162° 45′ W. at 1h. 7m. 40s. P.M. by a chronometer which was *slow* by 12m. 20s. for mean time at Greenwich; suppose the distance of the moon's *nearest limb* from the Star ALDEBARAN, (or α Tauri) to be 75° 56′ 30″; and the altitude of the moon's upper limb 59° 31′ 10″; with that of the star 20° 1′ 15″:—and at 5h. 56m. 40s. P.M. by the *same chronometer*, the altitude of the sun's lower limb was 23° 44′ 40″; the ship being then in latitude 16° 11′ S., the height of the eye at each observation being 16 feet, and the instruments properly adjusted: required the true longitude of the ship by both lunar observation and chronometer, *when the sun's altitude was taken, to determine the error of the chronometer in mean time at that meridian.*

Answer. The true distance 76° 6′ 57″; mean time at Greenwich, when the distance was observed 1h. 19m. 49s. past noon, December 25; mean time at ship when the altitude was taken for time 19h. 18m. 34s.: consequently the chronometer was then *fast* of that meridian by 10h. 38m. 6s. mean time at that meridian when the distance was taken 14h. 29m. 34s.; the longitude by lunar 162°33′45″ W., also by the chronometer 162°36′30″ W.

7. September 18, 1866, about 2h. 50m. P.M. mean time at ship, in latitude 35° 18′ N., and longitude by account 129° 25′ W., when a chronometer which was *slow* of Greenwich mean time 14m. 50s., shewed 11h. 7m. 10s. P.M the altitude of the sun's lower limb 37° 50′ 40″; and about 1h. 10m. afterwards, when the *same chronometer* shewed 12h. 17m. 5s., suppose the distance between the sun and moon to be 110° 54′ 15″; the altitude of the sun's lower limb 23° 55′ 40″; and the altitude of the moon's upper limb 18° 13′ 30″; the height of the eye 18 feet; the errors of the sextants being, *viz.*, from the distance − 0′ 45″; to the sun's altitudes + 1′ 15″; and from the moon's altitude − 1′ 10″: required the true longitude of the ship *when the sun's altitude was taken for time*, both by lunar observation, and the chronometer.

Answer. The mean time at ship when the sun's altitude was taken for time 2h. 44m. 49s. September 18, consequently the chronometer was *fast* of that meridian by 8h. 22m. 20s; the true distance 110° 56′ 23″, the corresponding time at Greenwich 12h. 32m. 8s.; and hence, the longitude by lunar observation 129° 21′ 0″ W., and by chronometer 129° 17′ 45″ W.

8. October 31, 1866, in latitude 30° 10′ S. and longitude by account 40° 0′ E. about 8h 30m. A.M. apparent time at ship, the altitude of the sun's lower limb being 39° 15′ 30″, and at 15m. 24s. after the sun's altitude was taken, suppose the distance between the sun and moon (measured by the same sextant) to be 82° 14′ 30″; the index error being 1′ 30″ −, and the height of the eye 24 feet: required the sun and moon's apparent altitudes when the distance was taken, and thence the true longitude of the ship.

Answer. The mean time at the ship when the sun's altitude was observed 20h. 14m. 30s., and when the distance was taken 20h. 29m. 54s. October 30; the sun's apparent altitude 42° 43′ 19″; the moon's apparent altitude 37° 38′ 30″; and the true distance 82° 11′ 47″; the corresponding mean time at Greenwich 17h. 50m. 5s. October 30; and consequently the true longitude of the ship 39° 57′ 15″ East.

METHOD OF KEEPING

A JOURNAL AT SEA.

A SEA JOURNAL is a book wherein is registered an exact and regular account of the various occurrences that happen on board a ship during her voyage; but more particularly those concerning the ship's way, in order that her situation may be known at any time required.

For this purpose there is kept in the steerage, or some other convenient part of every ship, a large board, painted black, called the *Log Board*, which is usually divided into six columns; the first, on the left hand, contains the 24 hours from the noon of one day to the noon of the following; the second and third columns are for the knots and fathoms the ship runs in half a minute, or the miles and parts in an hour;* the fourth column contains the courses steered by the compass; in the fifth the winds are entered; and in the sixth the various remarks, such as the state of the weather, the sails set or taken in, the observations made for ascertaining the ship's place, the variation of the compass, and whatever else may be thought necessary. All these particulars are entered every day at noon into a book, divided into columns exactly like the log-board, and called the *Log Book*. From this book the navigator makes the necessary deductions, relating to the ship's place, every day at noon; which operation is called a *Day's Work*.

While the ship is in port, the remarks entered in the log-book are called *Harbour Work*; and the account of the ship's way, &c., kept at sea, is termed *Sea Work*.

In harbour-work the day is estimated according to the civil reckoning, as on shore, that is, from midnight to midnight; but at sea, the days' works being made up at noon, are dated the same as the civil day, so that the days' works marked Monday, began on Sunday at noon, and ended on Monday at noon; hence the day by the ship's reckoning, which is called the nautical day, begins twelve hours before the civil day;† the first twelve hours, or those contained between noon and midnight, being marked P. M., signifying post meridiem, or afternoon; and the other twelve hours, A M., signifying ante meridiem, or before noon.‡

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* In the Royal Navy, and on board ships that undertake an East India, or other long voyage, the log is hove every hour, but in short trading vessels only once every two hours. This last circumstance makes no difference in the computation, excepting that the knots and fathoms run on every course by the log, must be doubled, to give the whole distance.

† In compliance with an order from the Admiralty, the Navy Logs are dated at midnight, in order to correspond with the civil mode of reckoning time. The form of a Navy Log will be shewn hereafter.

‡ As the astronomical day begins at noon of the civil day, which is the end of the nautical day, the declination of the sun, used in determining the latitude by a meridian altitude, is taken out from the Tables or the Nautical Almanac, for the noon of the civil day.

When a ship is bound from one place to another that lies so far from her that she is obliged to leave the land, at the time of losing sight of it, the bearing of some place is to be observed, whose latitude and longitude are known; which, together with the estimated distance of the ship from the land, is to be set down on the log-board. This is called *taking a departure.* The distance may, however, be more accurately known by taking the bearing twice, and noting the ship's course and distance between them, as shewn in the first example of Oblique Sailing, page 112.

TO CORRECT THE COURSES STEERED BY COMPASS.

The variation of the compass, which is usually found by observation, as already explained, must be applied to all courses steered, and on all bearings taken by the compass, in the following manner. Suppose yourself placed at the centre of the compass, and looking directly forward to the point you are to allow the variation from; then, if the variation be easterly, allow it to the right hand of the course steered, or bearing taken by compass; but if westerly, to the left hand; by which you will obtain the true course.

For example, suppose the course steered by compass is N. E. by N., and the variation is 1 point westerly; now, 1 point to the left hand of N.E. by N. is N. N. E., which is the true course required. Again, suppose I set a cape, and find it bear from me S. W. by compass, the variation being 1½ point easterly; here 1½ point allowed to the right hand of S. W. will give S. W. by W. ½ W., the true bearing of the land.

The courses must likewise be corrected for leeway, the nature of which may be thus explained. When a ship is close hauled, and the wind blowing fresh, that part of the wind which acts upon the hull and rigging, together with a considerable part of the force exerted on the sails, tend to drive her immediately from the direction of the wind, or, as it is termed, to leeward. But since the bow of a ship exposes less surface to the water than the side, the resistance will be less in the first case than in the second; the velocity, therefore, in the direction of her head, will, in most cases, be greater than the velocity in the direction of her side, and the ship's real course will be between the two directions. Now the angle contained between the line of the ship's apparent course, and the line she really describes through the water, is termed her *Leeway.*

The quantity of leeway to be allowed, will depend upon a variety of circumstances; as the mould or trim of the ship; the quantity of sail she carries; her velocity through the water; the sails being properly set to receive the action of the wind, &c.: hence no general rules can be laid down with accuracy that will determine the quantity of leeway at all times. The following have, however, been usually given by most writers on Navigation.

1. When the ship is close-hauled, has all her sails set, the water smooth, with a light breeze of wind, she is then supposed to make little or no leeway.
2. When the top-gallant sails are handed, allow one point;
3. When under double-reefed topsails, one point and a half;

4. When under close-reefed top-sails, two points;
5. When the top-sails are handed, three points and a half
6. When the fore-course is handed, four points;
7. When under the main-sail only, five points;
8. When under the balanced mizen, or mizen stay-sail, six points;
9. When under bare poles, seven points.

As these allowances depend entirely on the quantity of sail set, and the heave of the sea, without having any regard to the form of the ship, or nature of the cargo she may have on board, it is evident they can only be considered as probable conjectures, and may indeed serve to work up the day's work of a Journal that has been neglected. But since the computation of a ship's way depends much upon the accuracy of this allowance, it should always be the duty of the officer of the watch carefully to observe the leeway, and either allow it upon the courses steered before they are put down on the log-board, or else set it down in a column reserved for that purpose.

The leeway that a ship makes may be easily estimated thus: draw a small semicircle on the taffrail, with its diameter at right angles to the ship's keel, and divide its circumference into points and quarters; then observe the angle contained between the semidiameter which points right aft, and that which points in the direction of the wake, and it will be the leeway required. But the most accurate method of determining the leeway, is to have a semicircle drawn on the taffrail, as before described, with a low crutch or swivel in its centre. Then, after heaving the log, the line is to be slipped into the crutch just before it is drawn in, and the points and quarters contained between the direction of the log-line and the fore and aft line of the semicircle, will be the quantity of leeway.

The leeway being determined, it is to be allowed *from the wind*, that is, to the right hand of the course steered, when the larboard tacks are aboard, and to the left hand when the starboard tacks are aboard,* supposing yourself looking from the centre of the compass towards that point the ship's head is directed to. For example, suppose a ship sails S. W. by S. by compass, with her starboard tacks aboard, and she makes one point leeway; her course corrected for leeway will be S. S. W., being one point to the left of her course by compass. Again, if a ship close-hauled sails N. E. when the wind is N. N. W., and makes 1½ point leeway, her true course will be N. E. by E. ½ E.; because, having her larboard tacks aboard, 1½ point is to be counted to the right hand of the course by compass.

The Examples in the following Table, where the courses steered, with the leeway and variation to be allowed on each, are given, from thence to find the true courses, will serve to exercise the learner in the foregoing rules.

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* When a ship is close-hauled, certain ropes, called *tacks*, which are fastened to the lower corners of the main and foresails, are hauled forward on the weather side, or that next the wind, in which case those tacks are said to be aboard. When a ship is close-hauled, that is, when she sails as near the wind as she will lay, with the wind on the right hand, she has her starboard tacks aboard, and is said to sail on the starboard tack. But if the wind be on the left hand, in the same manner she has her larboard tacks aboard, and is said to sail on the larboard tack.

GIVEN.				TO FIND.
Courses steered.	Winds.	Leeway.	Variation.	Courses corrected.
E. N. E.	N. W.		1½ W.	N. E. ½ E.
W. by S.	N. W. by N.	1		W. S. W.
N. W by N.	N. E. by N.	1½	2 W.	W. N. W. ½ W.
South.	E. S. E.	½	1¼ E.	S. by W. ¾ W.
N. W.	W. S. W.	2	1 W.	N. W. by N.
S. S. W.	S. E.	1¼	1¼ W.	S. S. W.
E. by N.	N. by E.	2½	0¾ E.	S. E. by E. ¾ E.
West.	N. N. W.	¾	1 E.	W. ¼ N.

In hard blowing weather, with a contrary wind and a high sea, it is impossible to gain any advantage by sailing; in such cases, therefore, the object is to avoid, as much as possible, being driven back. With this intention it is usual to lie-to under no more sail than is sufficient to prevent the violent rolling which the vessel would otherwise acquire, to the endangering of the masts, yards, and rigging. When a ship is brought-to, the tiller is put gradually over to leeward, which brings her head round to the wind.* The wind then having very little power on the sails, the ship loses her way through the water, which ceasing to act upon the rudder, her head falls off from the wind, the sail which she has set fills, and gives her fresh way through the water; which, acting on the rudder, brings her head again to the wind. Thus, the ship has a kind of vibratory motion, coming up to the wind, and falling off from it, alternately.

When a ship is lying-to, observe the points on which she comes up and falls off, and take the middle point for the apparent course; on which allow the variation and leeway, and you will have the true direction of the drift. For example, suppose a ship lying-to under a main-sail, with her starboard tacks aboard, comes up E. by S., and falls off N. E. by E., there being one point westerly variation, and she makes 5 points leeway; what course does she make good? The middle point between E. by S. and N. E. by E. is E. by N., from which allowing 5 points to the left hand, because the starboard tacks are aboard, gives the course, corrected for leeway, N. N. E.; from which allowing 1 point to the left hand, because the variation is westerly, will give the true course N. by E.

In sailing along a coast, in a tide or current, particular care should be taken to observe its setting, which, with the variation allowed, is to be entered in the Traverse Table as a course, and its drift as a distance; the same is to be observed for the heave or swell of the sea.

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* It may be here mentioned as a caution, that when the tiller is put over, it should be lashed within *half a turn* of the wheel, in order that the rudder may have free play; and on no account should the helm be put hard over to leeward, as that would endanger the rudder, pintles, and gudgeons, or might even loosen the stern-post, by heavy seas striking against the back of the rudder: many serious accidents have occurred for want of due precaution in this respect.

On leaving the land, the opposite point to its bearing from the ship, with the variation allowed, and the estimated distance from it, are to be set down in the Traverse Table as a course and distance.

The computation made from the several courses, corrected as above, and their corresponding distances, is called a *Day's Work*; and the ship's place, as deduced therefrom, is called her Latitude and Longitude by *Account* or *Dead Reckoning*.

If the course and distance made good by a ship, as estimated from the compass and the log, could be accurately ascertained, nothing more would be necessary in determining a ship's place at any time during her voyage; for the course and distance being known, the difference of latitude and longitude, and hence the latitude and longitude she is in, may be readily found by any of the methods shewn in the various sailings; but on account of the many accidents that attend a ship's way, such as swelling of the sea; different rates of sailing between the times of heaving the log; want of care at the helm; unknown currents; sudden squalls; improper allowances for variation and leeway; the inaccuracy of the glass and log-line, &c.; the latitude of the ship, as deduced from the reckoning, will frequently differ considerably from the latitude by observation, and hence the difference of longitude, and longitude in by account will be likewise erroneous. Now, as the latitude by observation is always depended on, it remains, therefore, to correct the ship's longitude by account. For this purpose, examine whether the log-line and half-minute glass be just; and if you find they are not, correct the distance by the rules given in pages 61 and 62, and with the corrected distance and the course, find a new difference of latitude and departure; then, if this difference of latitude applied to the latitude left, give a latitude nearly the same as by observation, the error may be considered as sufficiently corrected, and the difference of longitude is to be found with this new latitude or departure. But if there still remain a considerable difference between the latitudes by account and by observation, consider carefully if the leeway and variation have been properly allowed; whether the ship's motion may not have been affected by a current, or heave of the sea; and if so, make the best estimation you can for its setting and drift.

If, after all proper allowances are made for errors in distance, currents, &c., the latitude by account and observed latitude should still disagree, it is then recommended by some authors to correct further for supposed errors in the courses and distances. Thus, if the course be near the meridian, the error is supposed to arise from the distance; because the error in the course must be sensible, to make any considerable error in the difference of latitude; if the course be nearly east or west, then the error is supposed to result from the course, as an error in the distance must be very great, to make a considerable one in the latitude; but if the course be near 4 points, then the error in the latitude is attributed partly to the course, and partly to the distance. The rules founded upon these suppositions, it must be confessed, are, in general, little better than guess-work; and are, therefore, omitted in this Work, being deemed useless, and frequently leading to greater errors than those they are intended to correct.

Notwithstanding that all the supposed corrections be applied with the greatest care to the ship's reckoning, it is frequently found, on making the land after a long voyage, that the longitude deduced from the dead reckoning alone, will differ very considerably from the truth: a good navigator will therefore lose no opportunity of ascertaining the ship's place by celestial observations; carrying forward the latitude so found, by applying to it the difference of latitude made from day to day by the reckoning, and to the longitude determined by a lunar observation, the difference of longitude made by chronometer, until another observation be taken. A separate statement is usually made of the longitude by dead reckoning, and of that by observations.

GENERAL RULES FOR WORKING A DAY'S WORK.

1. Enter in a Traverse Table the several courses steered, corrected for variation and leeway; and opposite each course place the whole distance run, as it appears by the log on summing up the knots and fathoms while the ship is on that course. Find the difference of latitude and departure answering to each course and distance, and set them down in their respective columns; then the difference between the sums of the northings and southings will be the difference of latitude made good, of the same name with the greater; and the difference between the sums of the eastings and westings will be the departure made good, of the same name with the greater quantity.

2. Seek in the several pages of the Traverse Table until the above difference of latitude and departure be found together in their respective columns: opposite to these will be the distance made good; and at the top or bottom of the page, according as the departure is less or greater than the difference of latitude, will be found the true course.

Or, it will save trouble, especially when the variation is given in degrees and the ship has made several courses during the 24 hours, if the magnetic or compass courses (corrected for leeway only) be entered in the Traverse Table; then with these courses, and the distance run on each, find the corresponding difference of latitude and departure, which will give the *magnetic course*, and the distance made good in the whole day; this course then being corrected for variation, will give the *true course*, with which, and the distance already found, you will obtain the *true* difference of latitude and departure.

3. If the latitude from which the ship's departure be taken, or yesterday's latitude, be of the same name with the difference of latitude, add them together; if not, take their difference; the sum or remainder will be the latitude at noon, by account, of the same name with the greater.

4. Find the complement of the middle latitude between yesterday's and to-day's latitude, which take as a course in the Traverse Table, and seek for the departure in its column; then will the distance corresponding to these be the difference of longitude, of the same name as the departure.

Or, seek for the course made good, and for the meridional difference of latitude in a lat. column; then will the corresponding departure give the difference of longitude, as before.

5. If the longitude of yesterday be of the same name with the difference of longitude, add them together; if not, take their difference; the sum or remainder will be the longitude in, of the same name with the greater.

6. To find the bearing and distance of the intended port, or any other place, from the ship, find the complement of the middle latitude between the ship and the proposed place; which seek in the Traverse Table as a course: in that page where it is found, look for the difference of longitude in a distance column, opposite to which will be the departure in its proper column; with this departure and the difference of latitude, find the *true* course or bearing, and the distance as before.

Or, look for the meridional difference of latitude and difference of longitude, till they are found opposite each other in the lat. and dep. columns, and they will give the *true* course; this course and the proper difference of latitude in the lat. column, will give the distance in its proper column

If the *magnetic* course or bearing be required, the variation must be allowed on the true bearing; to the right-hand, if the variation be westerly, or to the left-hand, if easterly.

There are various methods of keeping a Sea Journal, with regard to what deserves to be recorded, according to the sentiments of different persons: some approve of a journal including the log-book, each day's work at some length, and such occurrences as seem of most importance; while others prefer a short abstract of this long journal, containing little more than the course and distance run, the latitude and longitude in, and sometimes the bearing and distance to the intended port, for each day. There are likewise forms peculiar to the particular service to which a ship belongs, as in the Royal Navy and East India Merchant Service. These forms will be shewn hereafter.

We shall now proceed to exemplify the above Rules; first, by a few examples of separate Days' Works, and afterwards in a Journal from London to Madeira, kept in the form generally used in merchant ships, and containing most of the occurrences that happen to a ship in a common voyage, with supposed observations for ascertaining the latitude, longitude, variation, &c.

Note. In the following Days' Works and Journal, which are worked by inspection, the log is supposed to be hove every hour, and the knot divided into eight fathoms of six feet each. Also in all the astronomical observations introduced in this Journal, the height of the observer's eye is supposed to be 18 feet.

EXAMPLE I.

Yesterday, at noon, we were, by observation, in latitude 19° N., and in longitude 23° 4′ W.; and have sailed till noon this day, as per log; the variation of the compass being 1 point West: required the course and distance made good, with the present latitude and longitude of the ship.

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks.
1	5	4	S. W. ½ W.	N. E.		Moderate and clear, in the first and middle parts; latter, thick and cloudy, with drizzling rain.
2	5	2				
3	5	4				
4	5					
5	5					
6	5					
7	4	6				A stranger, shewing English colours, in the N. E. quarter, standing to the southward.
8	4					
9	4					
10	4					
11	3	4				
12	3	4				
1	4		N. W.	E. N. E.		
2	4					
3	3	2				
4	3					
5	3	6	S. W.			Set the fore-top-mast studding sail.
6	5	2				
7	5	4	S. S. W.			An increasing breeze and cloudy, with rain.
8	6					
9	7					
10	8					
11	7	4				
12	7					Variation 1 point West.

Courses.	Dist.	N.	S.	E.	W.
S. W. ½ S.	55		42.5		34.9
N. W. by W.	14	7.8			11.6
S. W. by S.	9		7.5		5.0
S. by W.	41		40.2		8.0
		7.8	90.2	Dep.	59.5
			7.8		
	Diff. lat.		82.4		

Lat. left ...... 19° 0′ N. ... Mer. Parts 1161
Diff. of lat. 82′ = 1 22 S.

Lat. in. by acc. 17 38 N. ... Mer. Parts 1075
Sum of lats.... 36 38
Middle lat. ... 18 19 Mer. diff. lat. 86
90

Co. mid. lat. 71 41

The first course steered by compass, viz. S. W. ½ W., being corrected for 1 point West variation, makes the true course S. W. ½ S.; and the knots and fathoms, summed up to midnight, give the distance run upon the first course, 55 miles: in the same manner the other courses are to be corrected, and, with their corresponding distances, are to be set down in a Traverse Table, as above. No leeway is allowed on the courses in this day's work, because the ship is going large.

The whole difference of latitude 82′.4, and the departure 59′.5, give the course made good S. 36° W., and the distance 102 miles.

The co. middle lat. 71° 41′ as a course, and the departure 59′.5 in a dep. column, give the diff. of longitude 62′.5 in a dist. column, by Middle Latitude Sailing.

Or, the course 36°, and mer. diff. of latitude 86′ in a lat. column, give the diff. of longitude 62′.4 in a dep. column, by Mercator's Sailing.

The difference of longitude 62 miles, or 1° 2′ W., added to the longitude of yesterday, 23° 4′ W., because they are both of the same name, gives the longitude in to-day 24° 6′ W

EXAMPLE II.

Yesterday, at noon, we were in latitude 35° 2′ N., and longitude 17° 45′ W.; at 7 o'clock, P. M., the sun was observed to set W. 43° N. by compass, his declination being at that time 18° 56′ N.; and we have sailed this day till noon, as per log, in a current setting S. W. 1 mile per hour all day; required the course and distance made good, and our present latitude and longitude.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks.
1	5		N. E. by N.	E. S. E.		Moderate breezes.
2	5	2				
3	5	2				
4	5					
5	5	4				
6	5					
7	4	6				The sun set W. 43° N., by which the variation is found to be 19° 29′, or 1¾ point, West.
8	4	2				
9	5					
10	5					
11	5	2	N. N. E.	East.	1	Fresh gales. In 2d. reef of the topsails.
12	5					
1	4	6				
2	4	2				
3	3	6				
4	3	4	N. E. ½ N.	E. by S.	1½	
5	3					
6	3					
7	3					
8	2	4				Cloudy.
9	2					
10	2	4				
11	2	4				
12	2					Lat. by obs. 36° 16′ N.

Before the courses can be corrected, the variation of the compass must be found by the amplitude taken at sunset. Now the ship's course from noon to 7 o'clock is N. E. by N., and the distance run 36 miles: but allowing the variation at last observation to be about 1½ point westerly, the corrected course will be N. by E. ½ E.; with which, and the distance 36 miles, the diff. of latitude made good since noon is found to be 34′ N.: this, added to the latitude at noon, 35° 2′ N., gives the latitude in, at sunset, 35° 36′ N.; with which, and the declination 18° 56′ N., the true variation is found as follows:—

Latitude ...... 35° 36′ N....Secant 0.08986
Declination... 18 56 N....Sine... 9.51117

True amp. W. 23 31 N....Sine... 9.60103
Mag. amp. W. 43 0 N.

Variation .... 19 29, or 1¾ point West.

The courses being corrected for variation and leeway, with their corresponding distances, together with the set and drift of the current, will be as in the Traverse Table.

Courses.	Dist.	N.	S.	E.	W
N. by E. ¼ E.	50	48.5		12.2	
N. ¾ W.	23	22.7			3.4
N. ¼ E.	24	24.0		1.2	
S. S. W. ¼ W. Current.	24		21.7		10.3
		95.2	21.7	13.4	13.7
		21.7			13.4
	Diff. lat.	73.5		Dep.	0.3

On summing up the columns of the Traverse Table, it appears that the ship has sailed due North: hence her distance made good is 73.5 miles, the same as the difference of latitude; and her longitude is the same as yesterday.

The difference of latitude 73.5 miles, or 1° 14′ N., added to the latitude left, 35° 2′ N., gives the latitude in, 36° 16′ N.

EXAMPLE III.

Yesterday, at noon, we were in latitude 38° 20′ S., and longitude 10° 34′ E. At 5 o'clock in the afternoon, the sun's bearing by compass was observed to be N. 75° 10′ W., his corrected altitude being at the same time 22° 15′, and declination 18° 47′ S.; and we have sailed till this day at noon as per log: required the course and distance made good, the latitude and longitude in, with the course and distance to the Cape of Good Hope.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks.
1	6		E. S. E.	N. N. E.		The first and latter part of these 24 hours a moderate breeze and cloudy; the middle, light airs and calms, attended with rain.
2	5	4				
3	6					
4	4					
5	1	6				
6	0	6				
7	Calm					
8						
9						
10	1		S. E.	Variable.		
11	3					
12	3		E. S. E.	S. by W.		
1	3					
2	4					
3	5	4				
4	5	4				
5	5					
6	5					
7	5			South.	½	In 1st reefs of the topsails.
8	4					
9	4	6				
10	5	6				
11	4					
12	4	4				No Observation.

Supposing the variation of the compass at last observation to have been about 2 points westerly, the ship has sailed nearly due East from noon to 5h. P. M.; consequently the latitude at that time may be considered the same as at noon. Now, with the latitude 38° 20′ S., the altitude 22° 15′, and the declination 18° 47′ S., the true azimuth is found to be N. 96° 54′ W., which, compared with the magnetic azimuth, N. 75° 10′ W., gives the variation 21° 44′ W.

Courses.	Dist.	N.	S.	E.	W.
S. 89° E.	55		1.0	55.0	
S. 67 E.	4		1.6	3.7	
N. 85 E.	28	2.4		27.9	
		2.4	2.6 2.4	86.6	Dep
	Diff. lat.		0.2		

The several courses, corrected for variation to the nearest degree, and for leeway after 7 o'clock A. M., with their corresponding distances, will be as in the Traverse Table; but it is to be observed, that as the distance run from noon to 6h. P. M., and from 11h. P. M. to 6h. A. M., are on the same course, this course is to be corrected, and with the *sum* of the corresponding distances, 55 miles, entered in the Traverse Table as a *single course and distance*

By the Traverse Table, it appears that the ship has sailed due East: hence her departure is equal to the distance run, and the latitude to-day is the same as that of yesterday. The difference of longitude is found by Parallel Sailing, as follows:—

The co. latitude 51° 40′ as a course, and the departure 86′.6 in a dep. column, give the diff. of longitude 110′ in a distance column.

The diff. of longitude 110′, or 1° 50′ E. added to the longitude of yesterday 10° 34′ E. gives the longitude of the ship to-day at noon, 12° 24′ E.

To find the Bearing and Distance of the Cape of Good Hope.

Lat. of C of G. Hope	34° 22′ S.......	Mer. Parts. .	2198	Long. of C. of G. Hope	18° 24′ E.
Latitude of ship......	38 20 S.......	Mer. Parts...	2494	Longitude of Ship......	12 24 E.
Diff. of latitude.	3 58=238′	Mer. diff. lat.	296	Diff. of longitude	6 0=360

Hence the bearing of the Cape of Good Hope is N. E. ½ E., and the distance 375 miles The course by compass is therefore N. 72° 22′ E., or E. N. E. ½ E. nearly.

EXAMPLE IV.

Yesterday, at noon, we were in latitude 6° 38′ N., and longitude 26° 10′ W. At 7 o'clock this morning we observed the distance of the sun and moon, which gave our longitude at that time 26° 58′ W.; and, by double altitudes, we were in latitude 7° 47′ N. at 10h. 30m. A. M.: required the course and distance made good by the log, the latitude and longitude at noon by dead reckoning, and the same by the observations.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks.
1	6		N. W. by N.	N. E.		A pleasant breeze with fair weather throughout.
2	6					
3	5					
4	5					
5	5	4				
6	5	4				
7	5					
8	5					
9	5			N. E. by E.		
10	5					
11	4	6				
12	4	4				
1	5					
2	5	2				
3	5					
4	5					
5	5					
6	5					
7	5	2				
8	5	4				
9	6	4				
10	6					
11	6	2				
12	6					Variation by azimuth 8° W.

The variation 8° W. being allowed to the left of N. W. by N., gives the corrected course N. 42° W.; and the knots and fathoms summed up, give the distance run by the log in 24 hours, 128 miles: hence the difference of latitude is 95′.1, and the departure 85.6 miles.

Latitude left...........	6° 38′ N.	
Diff. of latitude 95′, or	1 35 N.	
Latitude in by account	8 13 N.	

Latitude left.....	6° 38′ N.
Latitude in......	8 13 N.
Sum...............	14 51
Middle latitude..	7 25
Com. of mid. lat.	82 35

The com. of middle latitude 82° 35′, and the departure 85′.6, give the difference of longitude 86 miles, or 1° 26′; which, added to the longitude of yesterday, 26° 10′ W., gives the longitude in, by account, 27° 36′ W.

To reduce the Observations to Noon.

The course N. 42° W., and the distance run from 10h. 30m. A. M., till noon, viz. 9 miles, give the diff. of latitude 7′ N.; which added to the latitude by double altitudes 7° 47′ N., their sum, 7° 54′, is the latitude by observation reduced to noon.

The course N. 42° W., and the distance run since 7 o'clock in the morning, 30 miles, give the departure made in that interval 20′.1, and the diff. of latitude 22′.3.

Lat. by observation at noon......	7° 54′ N.
Diff. of lat. from 7h.A.M. to noon	— 22 N.
Lat. by obs. at 7h. A. M.	7 32 N.

Lat. at noon......	7° 54′ N.
Lat. at 7h. A. M...	7 32 N.
Sum................	15 26
Middle latitude...	7 43
Com. of mid. lat.	82 17

The com. of middle latitude 82° 17′, and the departure 20′.1, give the diff. of longitude made from 7h. A. M. to noon, 20′ W.; which added to 26° 58′ W., the longitude by the observation, their sum, 27° 18′ W., will be the long. by observation brought on to noon.

JOURNAL

OF A

VOYAGE FROM ENGLAND TO MADEIRA,

IN THE SHIP

BRITANNIA,

GEORGE COLEMAN, COMMANDER,

KEPT BY A. B. MARTIN, MATE.

1866.

Date.	Winds.	Remarks on Board the Ship BRITANNIA, 1866.
Thursday. June 7.	S. S. W. S.W.	Moderate and clear. At 6h. A.M. the Pilot came on board. At 8h. A. M. cast loose from the sheer hulk at Deptford, and made sail down the river. At 2h. P. M. anchored in Long Reach, and moored ship with a cable each way.
Friday. June 8.	W. by S.	Fresh gales with showers. P. M. received on board the carpenter's and boatswain's stores.
Saturday. June 9.	S.S.W. to N. N. W.	Light airs and fine weather. At 6h. A. M. unmoored, and hove short on the best bower. At noon weighed with a light breeze from the westward. At 3h. P.M. came to with the best bower off Gravesend. Received a chronometer on board, which was 1m. 45s. slow for Greenwich mean time, and losing daily 2.5s.
Sunday. June 10.	W.N.W.	Moderate weather and fair. At daylight weighed and made sail. At 1h. P.M. anchored with the best bower at the Nore, in 9 fathoms. At 5h. P. M. weighed and sailed through the Queen's Channel. At 8h. 30m. P.M. came to with the best bower at the back of Margate Sand.
Monday. June 11.	N. by E. N.	Moderate wind and cloudy, with showers. At 6h. A. M. weighed and made sail. At 8h. A.M. ran through the Gull Stream, and came to an anchor in the Downs, in 7 fathoms, about 1 mile off shore, Deal Castle bearing W.N.W., the South Foreland S.W., and the North Foreland N.N.E. P.M. the Pilot left the ship.
Tuesday. June 12.	N. N. E.	A pleasant breeze with fair weather throughout. A.M. employed filling up the water, stowing the booms and boats, and getting all clear for sea. At 10h. A.M. weighed and made sail. At noon the South Foreland upper Lighthouse bore N.N.W., distant about 4 miles. This log contains 12 hours, and ends at noon, to commence sea logs.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Wednesday, June 13, 1866.
1	1	2	W.S.W.½W.	N. N. E.		Light winds and clear.
2	1	4				
3	2					
4	3					
5	3	2				
6	3	4				
7	3					
8	3	4				
9	2	4	W. ¼ N.			
10	2	4				Dungeness Light North.
11	3					
12	3					
1	3	4				
2	4					
3	4	2				
4	4	2				Beachy Head revolving Light W. N. W.
5	4	4				
6	5					In 1st. reef of the topsails.
7	5	2				
8	6	2				
9	7		W.N.W.¼W.	N. E.		Brisk gales.
10	7	4				
11	8					
12	8	4				Bembridge Point N. N. W. ¼ W.

Course.	Dist.	Diff. lat.	Dep.	Latitude. Acc.	Latitude. Obs.	Diff. long.	Longitude. Acc.	Longitude. Obs.	Bearing and Distance at noon.
								☽ Chr.	

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Thursday, June 14, 1866.
1	8		W. N. W.	N. E. by N.		Fresh breezes and fair throughout.
2	8					At ½ past 1 abreast of St. Catherine's Point, off shore about 3 miles.
3	8					
4	7	6				
5	7	2				St. Aldan's Head N. W. ¼ W.
6	7		West.			
7	7					
8	6	4				
9	6					Portland Light N. N. W.
10	6					
11	6					
12	6			E. N. E.		
1	5					
2	5					
3	5	4				Out reefs of the topsails.
4	5					
5	5					
6	5					
7	6		N. W. by W.			
8	6	2				Two strange sail in sight on the weather bow, standing up channel.
9	6					
10	6					
11	5		W. by N.			
12	5					At noon mustered the ship's company.

Course.	Dist.	Diff. lat.	Dep.	Latitude. Acc.	Latitude. Obs.	Diff. long.	Longitude. Acc.	Longitude. Obs.	Bearing and Distance at noon.
								☽ Chr.	

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Friday, June 15, 1866.
1			W. by. N.	E. N. E.		A brisk wind and clear, in the first and middle parts; latter thick, cloudy weather, with drizzling rain.
2						
3						
4						
5						
6						At 6 P. M. the Lizard bore N. E. by N. distant 3 leagues; from which I take my departure.
7	4					
8	3	4				
9	3	6				
10	3					
11	3			N. by W.		
12	3	6				
1	4					
2	4	4	S. W. ½ W.			
3	5					
4	5					A. M. stowed the anchors, unbent the cables, and coiled them down in the tier.
5	5					
6	4	4				
7	4	6				
8	5					
9	5					
10	6					At noon sounded. Ground 76 fathoms; sand, shells, and hakes' teeth.
11	5					
12	5	2				Variation 2¼ points West.

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 37° W.	81′	65′ S.	49′ W.	48° 53′		76′ W.	6° 27′	☽ Chr.	

As the Lizard is the last point of land in sight, the ship's departure is taken from thence, supposing it to be in latitude 49° 58′ N., and longitude 5° 11′ W.: now, as the bearing of the Lizard from the ship was N. E. by N., the bearing of the ship from the Lizard was S. W. by S.; but as this is the bearing by compass, the variation 2¼ points W. is to be allowed to the left hand, which will give the true bearing S. ¾ W.; this is to be entered in the Traverse Table as a course, and 3 leagues, or 9 miles, the supposed distance of the Lizard from the ship, as a distance run. The courses, corrected for variation, and the distance run by the log, after 6h. P. M., are also to be set down in the Traverse Table, as follows :—

True Courses.	Dist.	N.	S.	E.	W.
S. ¾ W.	9		8.9		1.3
W.S.W.¾ W.	25		6.1		24.3
S.S.W.¼ W.	55		49.7		23.5
		Diff. lat.	64.7	Dep.	49.1

The diff. of lat. 64 .7 S. and departure 49′. 1 W. give the course made good from the Lizard S. 37° W., and the distance 81 miles.

Lat. of the Lizard	49°	58′	N.	Mer. Parts..	3471
Diff. of. lat. 65m. or	1	5	S.		
Lat. in by acc.......	48	53	N.	Mer. Parts..	3371
Sum of latitudes...	98	51			
Middle latitude ...	49	25		Mer.diff.lat.	100
Co. mid. latitude..	40	35			

The course 37°, and the mer. diff. of lat. 100′, give the diff of long. 75′.2; or the co. mid. lat. 40° 35′ as a course, and the departure 49′. 1 in a dep. column, give the diff. of longitude in a dist. column 75. 5 miles, or .... 1° 16′ W.

Longitude of the Lizard .... 5 11 W.

Longitude in by account .... 6 27 W.

The course and distance made good, the whole diff. of lat. and departure, the lat. and long. in by account, &c. are now to be set down in their respective columns, as above.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Saturday, June 16, 1866.
1	5	4	S. W.	N. by W.		A moderate breeze with fair weather for the most part; latterly thick and cloudy.
2	5					
3	5					
4	4	4		N.W. by N.		
5	4					
6	4		W. by S.		½	
7	4					
8	3	6				In 1st. reef of the topsails.
9	3	2				
10	3					Tacked ship.
11	3		N. W. by W.	S.W. by W.	1	
12	3					
1	2					
2	2					At 2h. A. M. the mer. alt. of the star α Aquilæ or Altair, was 50° 14′ S., which gives the lat. 48° 22′ 00″N.
3	3					
4	4					
5	4					Tacked
6	4	4	S. by E.		¼	
7	4	4				Out reefs of the topsails.
8	5					
9	5					Tacked.
10	5		West.	S. S. W.	¼	Spoke a brig, bound to Newfoundland.
11	5					
12	5					Variation 2¼ points West

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs		Acc.	Obs.	
S. 42° W.	64′	47′ S.	42′ W.	48° 6′	48° 6′	64′ W.	7° 31′	☽ Chr.	Cape Finisterre, S. 13½° W., 319m.

The courses corrected for variation and leeway, with their corresponding distances, will be as in the following Traverse Table.

True Courses.	Dist	N.	S.	E.	W.
S. by W. ¾ W.	24		22.6		8.1
S. W. ¼ W.	18		12.1		13.3
W.N.W. ¼ W.	21	7.1			19.8
S. E. ¼ S.	19		14.1	12.8	
W. S. W	15		5.7		13.9
		7.1	54.5	12.8	55.1
			7.1		12.8
		Diff. lat.	47.4	Dep.	42.3

With the diff. of latitude 47′.4 S. and the dep. 42′.3 W., the course is found to be S. 42° W., and the distance 64 miles.

Yesterday's lat.	48° 53′ N.		Mer. Parts...	337
Diff. of lat.......	47 S.			
Lat. in by acc..	48 6 N.		Mer. Parts...	3301
Sum of lats. ...	96 59			
Middle lat.	48 29		Mer. diff. lat.	70
Co. mid. lat. ...	41 31			

The latitude found by the star α Aquilæ at 2h. A. M. being brought forward by the log. from that time to noon, places the ship in latitude 48° 6′ N.

The course 42° and mer. diff. of lat. 70′, give the diff. of long. 63′; or the co. mid lat. 41° 31′, with the dep. 42′.3, give the diff. of long. 64m., or .... 1° 4′ W.
Yesterday's longitude............ 6 27 W.

Longitude in by account ..... 7 31 W.

To find the Bearing and Distance of Cape Finisterre.

Latitude of ship..... 48° 6′ N. ...... Mer. Parts... 3301 Longitude of ship ..... 7° 31 W.
Lat. of C. Finisterre 42 56 N.. .. Mer. Parts... 2858 Long. of C. Finisterre 9 16 W.

Diff. of latitude...... 5 10=310′. Mer. diff. lat. 443 Diff. of longitude 1 45=105′

The mer. diff. lat. 443′, and diff. of long. 105′, give the true course or bearing S. 13½° W.; which course, and the proper diff. of lat. 310m., give the distance 319 miles. The magnetic or compass bearing is S. W. ½ S. nearly

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Sunday, June 17, 1866.
1	5		West.	S. S. W.	¼	The first part a fresh breeze and cloudy; the middle and latter clear weather, and less wind, with a heavy swell from the S. W., for which I allow 12 miles.
2	5					
3	4	6				
4	4					
5	4	4				People employed pointing a new main-sail, and drawing and knotting yarns.
6	4	2				
7	4					At 7h. 56m. P. M. the sun set W. 58°50′ N. by compass, which makes the variation 22° 31′, or 2 points, West.
8	4					
9	4					
10	4					
11	3	6			½	Saw a stranger, under all sail, standing to the N. Eastward.
12	3	6				
1	3	4				
2	3					Pumped ship at 14 inches water.
3	3					
4	3					
5	2		W. S. W.	South.	1	
6	2					At 5h. 15m. A. M. the mer. alt. of the star Marcab was 56° 43′ 35″ S., which places the ship in latitude 47° 50′ 19″ N.
7	2	2				
8	2	4				
9	2	6				
10	2	4				
11	3					Obs. mer. alt. of ☉'s L. L. 65° 29′ 20″ S.: hence the lat. by obs. is 47° 42′ 59″ N.
12	3					

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 74° W.	75′	21′ S.	72′ W.	47°45′	47°43′	108′ W.	9° 19′	☽ Chr.	Cape Finisterre. South, 287m.

This day the swell setting from the S. W. is supposed to drive the ship 12 miles to the N. E., which, corrected for variation, is N N. E.; these are therefore set down as the *last course* and *distance* in the Traverse Table.

True Courses.	Dist.	N.	S.	E.	W.
W.S.W. ¼ W.	44		14.8		41.4
W.S.W. ½ W.	20		5.8		19.1
S. W. by W.	20		11.1		16.6
N. N. E. Swell.	12	11.1		4.6	
		11.1	31.7	4.6	77.1
			11.1		4.6
		Diff. lat.	20.6	Dep.	72.5

The diff. of lat. made between noon and sunset, *viz.* 10′ S., subtracted from 48°6′ N., the lat. at last noon, gives the lat. 47° 56′ N. at 7h. 56m. P. M., when the amplitude was taken.

The lat. 47° 50′ N. at 5h. 15m. A. M., by the star's mer. alt., being brought up to noon by the log., makes the lat. 47° 44′ N.

With the diff. of lat. 20′. 6, and the departure 72′. 5, the course is S. 74° W., and the distance 75 miles.

Yesterday's lat... 48° 6′ N. ... 48° 6′ N.
Diff. of lat. by acc. 21 S.

Lat. in by acc.... 47 45 N. (Obs.) 47 43 N.

Sum of latitudes 95 49
Mid. latitude 47 54
Co. mid. latitude 42 6

The co. mid. lat. 42° 6′, and the departure 72′. 5 give the diff. of long. 108′ or... 1° 48′ W
Yesterday's longitude............... 7 31 W.

Longitude in by account .... 9 19 W.

Note.—The course being large, the diff. of long. is found by middle latitude in preference to Mercator's Sailing.

To find the Bearing and Distance of Cape Finisterre.

Lat. of ship by obs... 47° 43′ N. ...... Mer. Parts... 3266 Longitude of ship...... 9° 19′ W
Lat. of C. Finisterre 42 56 N. ...... Mer. Parts... 2858 Long. of C. Finisterre 9 16 W.

Diff. of latitude ..... 4 47 = 287′ Mer. diff. lat. 408 Diff. of longitude...... 3′

Hence the true course is nearly South, the compass course S. S. W., and the dist. 287 miles.

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Monday. June 18, 1866.
1	3		West.	S. S. W.	1	
2	3					Mostly fresh breezes throughout, with cloudy
3	3	2				weather, and rain at times.
4	3	2				In 1st. reef of the topsails.
5	4					
6	4					
7	4	4				Tacked ship.
8	5		S. S. E.	S. W.	¼	At 10h. 8m. P. M., the obs. alt. of the Polar
9	5					Star was 46° 19′ N., which gives the latitude
10	5					47° 19′ 11″ N.
11	5		S. by E.	S.W. by W.		
12	5	2				At 12h. the foot rope of the mizen topsail
1	5	4				gave way; unbent it, and bent another.
2	5	2				
3	5					
4	5	4	S. by W.	W. by S.		At 9h. 26m. 14s. A. M. the alt. ⊙'s L. L. was
5	5	6				50° 37′ 30″, bearing by compass S. E.; and
6	6					at 11h. 24m. 34s. the alt. ⊙'s L. L. was
7	6					65° 43′ 10″, which gives the lat. by double
8	6	4				altitudes 46° 6′ N.
9	7					
10	7	2				
11	6					
12	6					Variation 2 points West.

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 7° E.	92′	92′ S.	12′ E.	46°11′	46° 3′	18′ E.	9° 1′	☽ Chr.	Cape Finisterre, S. ¼ W., 187m.

True Courses.	Dist.	N.	S.	E.	W.
W. by S.	25		4.9		24.5
S. E. ¼ E.	15		10.1	11.1	
S. E. by S.	26		21.6	14.4	
S. by E.	56		54.9	10.9	
	Diff. lat.		91.5	36.4	24.5
				24.5	
			Dep.	11.9	

The lat. by the Polar Star at 10h. 8m. P.M. being 47° 19′ N., and the ship having made by the log 76′.5 of southing to noon, give the lat. at that time 46° 2½′ N.

The diff. of latitude 91′.5, and dep. 11′.9, give the course S. 7° E. and the distance 92 miles.

Yesterday's lat. by obs. 47° 43′ N. Mer. Pts. 3266
Diff. of lat. by acc. 92′ or 1 32 S.

Lat. in by account ... 46 11 N.

Lat. in by obs.......... 46 3 N. Mer. Pts. 3120

Mer. diff. of lat. by obs. 146

The course 7°, and the mer. diff. of lat. by obs. 146′, give the diff. of long....... 0° 18′ E.
Yesterday's longitude................ 9 19 W

Longitude in by account .... 9 1 W

The latitude by double altitudes, when the greater alt. was observed, is 46° 6′ N., which, corrected for the run of the ship to noon, places her in lat. 46° 3′ N. at that time.

To find the Bearing and Distance of Cape Finisterre.

Lat. of ship by obs.. 46° 3′ N. ...... Mer. Parts... 3120   Longitude of ship ..... 9° 1′ W.
Lat. of C. Finisterre 42 56 N. ...... Mer. Parts... 2858   Long. of C. Finisterre 9 16 W.

Diff. of latitude..... 3 7 = 187′   Mer. diff. lat. 262   Diff. of longitude...... 15′

Hence the true course is about S. ¼ W., the magnetic course S S. W. ¼ W., and the distance 187 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Tuesday, June 19, 1866
1	6		S. by W.	W. by S.		Fresh breezes throughout, with fair weather and smooth water.
2	7					
3	7					People employed under the Boatswain.—Carpenter making a top-mast studding-sail boom.
4	6	6				
5	6					
6	6	4	S. by E.	S.W. by W.		Sail-maker making a quarter-deck awning.
7	6	4				
8	6	4				
9	6	4				
10	6	4				Tacked. At 10h. P. M. obs. alt. of the Polar Star was 44 2′ N., which makes the latitude 45° 3′ N.
11	6	6	West.	South.		
12	7					
1	7					
2	7					
3	7	4				At 6h. 30m. A. M. the sun's azimuth by compass was S. 81° 10′ E., the alt. of its L. L. 19° 46′ 10″, and the lat. brought on by the log from 10h. P. M., 44° 39′ N., which give the variation 22° 32′ W.
4	8					
5	8					
6	8					
7	7	4				
8	7	4				Passed by a ship under American colours standing to the eastward.
9	7	2	W. by S.			
10	7	4				Mer. alt. ⊙'s L. L. 68° 56′ 00″ S., hence the lat. by obs. 44° 18′ 53″ N
11	7			S. by W.		
12	7					

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 33° W.	124′	104′ S.	67′.5 W.	44° 19′	44° 19′	96′ W.	10° 37′	☽ Chr.	Cape Finisterre S. 35° E. 101.5 m.

Magnetic Courses.	Dist.	N.	S.	E.	W.
S. by W.	33		32.4		6.4
S. by E.	32		31.4	6.2	
West.	74				74.0
W. by S.	29		5.7		28.4
	Diff. lat.		69.5	6.2	108.8
					6.2
				Dep	102.6

In this Traverse Table, the magnetic or compass courses are entered, which give the diff. of lat. 69′.5, and the departure 102′.6; corresponding to these are the magnetic course S. 56° W., and the distance 124 miles.

Magnetic or compass course, S. 56° W.
Variation by azimuth .... 23 W.
True course ....S. 33 W.

Yesterday's lat. by obs. 46° 3′ N. Mer. Pts. 3120
Diff. of lat. 104m. or 1 44 S.

Lat. in by account ... 44 19 N. Mer. Pts. 2972

Sum of latitudes ...... 90 22 Mer. diff. lat. 148
Mid. latitude............ 45 11
Co. mid. latitude ...... 44 49, and the dep. 67′.5 give the diff. of longitude 96 miles.

The true course S. 33° W., and the distance 124 miles, give the true diff. of latitude 104′.0, and the true dep. 67.5 miles. The course S. 33° W., and the mer. diff. of latitude 148′, give the diff. of longitude 96m. or .... 1° 36′ W.

Yesterday's longitude .... 9 1 W.

Longitude in by account ......10 37 W.

To find the Bearing and Distance of Cape Finisterre.

Lat. of ship by obs.... 44° 19′ N.......Mer. Parts... 2972 Longitude of ship...... 10° 37′ W.
Lat. of C. Finisterre. 42 56 N.......Mer. Parts... 2858 Long. of C. Finisterre.. 9 16 W.

Diff. of latitude. .... 1 23 = 83′ Mer. diff. lat. 114 Diff. of longitude .... 1 21 = 81′

Hence the true bearing of Cape Finisterre is S. 35° E., or S. 12½° E. by compass, and the distance 101.5 miles.

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks Wednesday, June 20, 1866.
1	6	6	W. by S.	S. by W.		Strong breezes, with rain, attended with
2	6	2				hard squalls, thunder, and lightning.
3	6					In 1st. reef of the topsails.
4	5					
5	5					Tacked.
6	5		S. E. by S.	S. W by S.	1	Squally. In top-gallant sails.
7	5					In 2d. reef of the top-sails.
8	4					Down top-gallant yards.
9	4		S. S. E.	S. W.	1	
10	4					Hard squalls. Handed the main-sail and
11	3	6				mizen top-sail.
12	3					Close reefed, and handed the fore and main
1	–		up S. by E.		5	top-sails, and brought the ship to under a
2	–		off SE. by E.			fore-sail, mizen, and main stay-sail.
3	–		up W. by S.	Variable.		Wore ship.
4	–		off NW by W		5	
5	3		W. by N.	S. W. by S.	1½	At daylight more moderate. Set the top-
6	3					sails double reefed, and the main-sail. Up
7	4					top-gallant yards.
8	4	6	West.	S. S. W.	1½	Fair weather. Out all reefs of the top-sails.
9	4	2				Set the top-gallant sails.
10	4					
11	4					
12	4					Variation 2 points West.

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. W.	41′	29′ S.	29′ W.	43° 50′		40′ W.	11° 17′	☽ Chr.	Cape Finisterre S. E. by E. ¼ E. 105m.

It appears by this day's log, that the ship has been lying-to from midnight to 4h. A. M.; therefore the middle points between those the ship comes up to and falls off to, corrected for leeway, as directed in page 303, together with the drift, which is here assumed at 1 knot an hour, are inserted in the Traverse Table as the fourth and fifth magnetic courses and distances.

Magnetic Courses.	Dist.	N.	S.	E.	W.
W. by S.	29		5.7		28.4
S. E.	14		9.9	9.9	
S. E. by S.	15		12.5	8.3	
East.	2			2.0	
N. N. W.	2	1.9			0.8
W. N. W. ½ N.	10	4.7			8.8
W. N. W. ½ W.	21	6.1			20.1
		12.7	28.1	20.2	58.1
			12.7		20.2
		Diff. lat.	15.4	Dep.	37.9

The diff. of lat. 15′.4, and dep. 37′.9, give the magnetic course 6 pts. or W. S. W., and the distance 41 miles.

The variation 2 pts. West, allowed on the magnetic course W. S. W., give the true course S. W., which, with the dist. 41 miles, give the true diff. of lat. 29′.0 S., and the true departure 29′.0 W.

Yesterday's lat.......44° 19′ N....Mer. Parts. 2972
Diff. lat. by acc....... 29 S.

Latitude in by acc. 43 50 N....Mer. Parts. 2932
Sum of latitudes ...88 9
Mid. latitude ....44 4 Mer. diff. lat. 40
Co. mid. latitude ...45 56

The comp. of mid. lat. 45° 56′, and dep. 29′.0, or the course 4 pts., and mer. diff. of lat. 40′, give the diff. of long. 40′ W., which added to yesterday's long. 10° 37′ W., give the long. in by acc. 11° 17′ W.

To find the Bearing and Distance of Cape Finisterre.

Latitude of ship ...... 43°50′ N......Mer. Parts ... 2932 Longitude of ship......11°17′ W.
Lat. of C. Finisterre.. 42 56 N......Mer. Parts ... 2858 Long. of C. Finisterre 9 16 W

Diff. of latitude ...... 54′ Mer. diff. lat. 74 Diff. of longitude ...... 2 1=121

Hence the true bearing of Cape Finisterre is S. E. by E. ¼ E., or S. E. ¾ S. by compass, and the distance 105 miles.

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Thursday, June 21, 1866.
1	4		West.	S. S. W.	1¼	Fair Weather throughout.
2	4					
3	4					At 6h.10m. P.M. the ⊙'s azimuth by compass was N. 52° 20′ W., the altitude of his L.L. 16° 40′ 20″, and the latitude 43° 45′ N.,* which give the variation 21° 2′ W.
4	4					
5	4					
6	4	6	W. by S.	S. by W.	1	
7	5					
8	5	2				
9	5		S. W. by W.	S. by E.	½	At 10h. 22m. P. M., the mer. alt. of the star Antares was 20° 25′ 37″ S., which makes the latitude 43° 33′ 7″ N.
10	5					
11	5					
12	5					
1	5					
2	5					
3	5					
4	5	6	S. W.	S. E. by S.		
5	5					
6	5					
7	4	4				
8	4					
9	4	2				
10	4					Mer. alt. ⊙'s L. L. 70° 38′ 10″ S., hence the lat. at noon by obs. is 42° 37′ 40″ N.
11	4	4				
12	4					

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 46° W.	103′	72′ S.	74′ W.	42° 38′	42° 38	103′ W.	13° 0′	☽ Chr.	Porto Santo, S. 15° W., 569m.

Magnetic Courses.	Dist.	N.	S.	E.	W.
W. by N. ¼ N.	20	4. 9			19. 4
West.	15				15. 0
SW. b. W ½ W	35		16. 5		30. 9
S. W.	41		29. 0		29. 0
		4. 9	45. 5	Dep.	94. 3
			4. 9		
		Diff. lat.	40 6		

The diff. of lat. 40′. 6, and the dep. 94′. 3, give the magnetic course S. 67° W, and the distance 103 miles.

The variation 21° W., allowed on the magnetic course, give the true course S. 46° W., which with the distance 103m., give the true diff. of lat. 71′. 5, and true departure 74.′1.

Yester 'slat by acc. 43° 50′ N. Mer. Parts 2932
Diff. of lat. 71′.5 or 1 12 S.

Lat. in by account. 42 38 N. Mer. Parts 2833
Sum of latitudes ... 86 28
Middle latitude ... 43 14 Mer. diff. lat. 99
Co. mid. latitude... 46 46

The co. mid. lat, 46° 46′, with the dep. 74′.1, give the diff. of long. 101m. or the course 46°, and mer. diff. lat. 99, give the diff. of long. 102′. 5.

Yesterday's long. by acc. ...... 11 17′ W.
Diff. of long. 102. 5m. or...... 1 43 W.
Longitude in by Account ... 13 0 W.

To find the Bearing and Distance of Porto Santo.

Lat. of Ship by obs. 42° 38′ N............Mer. Parts... 2833 Longitude of ship... 13° 0′ W.
Lat. of Porto Santo 33 3 N...........Mer. Parts... 2103 Long. of Porto Santo 16 19 W.

Diff. of latitude ... 9 35 = 575′ Mer. diff. lat. 730 Diff. of longitude... 3 19 = 199′

The mer. diff. lat. 730′, and the diff. of long. 199′, give the true course S. 15° W.; this course and the proper diff. of lat. 575′, give the distance 596 miles. The course to be steered is therefore S. 36° W., or S. W. ¾ S. nearly.

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* In working up the log. from noon to 6h. 10m. P. M., the latitude, when the Azimuth was taken, is found to be 43° 45′ N., and the longitude by account at that time 11° 51′ W., with which, the variation is found as above.

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Friday, June 22, 1866.
1	4		S. W.	S. E.		Variable light breezes and calms, with hot sultry weather throughout.
2	4					
3	3	6				People and tradesmen employed variously.
4	3	2				
5	3					Tried the current, and found it setting N. E. by N. at the rate of ½ a mile per hour.
6	2	4				
7	2	4		Variable.		
8	3					
9	2					At 12h. 31m. P. M. the mer. alt. of the star Lyra or Vega was 86°27′45″ S. which gives the lat. 42° 16′11″N.
10	2					
11	2					
12	1					
1						At 4h. 30m. A. M. the sun's amplitude by compass was E. 12°14′N. and the lat. 42°16′N. which give the variation 20° 18′ W.
2						
3						
4				Calm.		
5						At 8h. A. M. observed as follows:—
6						Times by Chron. Obs. alt. Sun's L.L.
7	1		S. W. by S.	N. E. by E.		* 20h. 47m. 58s. 36° 38′ 30″
8	1	6				49 2 47 40
9	2					50 4 56 30
10	2	4		E. by N.		
11	3					Obs. mer. alt. ⊙'s L. L. 71° 12′44″ S.; hence the lat. at noon by obs. is 42° 2′ 58″ N.
12	3	6				

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 24° W.	35′	32′ S.	14′ W.	42° 6′	42° 3′	21′ W.	13° 21′	☽ Chr. 13° 2′	Porto Santo, S. 16° W., 562m.

By this day's log, it appears that the current set N. E. by N. by compass, and the drift was at the rate of half a mile per hour, making 12 miles in the 24 hours; these are therefore set down in the Traverse Table as a course and distance.

Magnetic Courses.	Dist.	N.	S.	E.	W.
S. W.	33		23.3		23.3
S. W. by S.	14		11.6		7.8
N. E. by N. Current	12	10.0		6.7	
		10.0	34.9	6.7	31.1
			10.0		6.7
		Diff. lat.	24.9	Dep.	24.4

The diff. of lat. 24′. 9, and dep. 24′. 4, give the magnetic course S. 44° W. and the dist. 35 miles.

The variation 20° 18′ W. allowed on the magnetic course S. 44° W., gives the true course S. 23°42′ W., which, with the distance 35 miles, gives the true diff. of lat. 32′. 0, and true departure 14′. 2.

Yester.'s lat. by obs. 42° 38′ N. Mer. Parts 2833
Diff. of lat. by acc. 32 S.

Lat. in by acc....... 42 6 N.

Lat. in by obs....... 42 3 N. Mer. Parts 2786

Mer. diff. lat. by obs. 47

The course 24°, and the mer. diff. of lat. by obs. 47′, give the diff. of long.......... 0° 21′ W.
Yesterday's long. by acc. ......13 0 W

Longitude in by account ......13 21 W

To find the Bearing and Distance of Porto Santo.

Lat. of ship by obs.... 42° 3′ N. ......Mer. Parts... 2786 Longitude by chron. 13° 2′ W.
Lat. of Porto Santo... 33 3 N. ......Mer. Parts... 2103 Long. of Porto Santo 16 19 W

Diff. of latitude...... 9 0 = 540′ Mer. diff. lat. 683 Diff. of longitude ... 3 17 = 197
Hence the true course is S. 16° W., magnetic course S. 36° W., and distance 562 miles

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* The chronometer was received on board June 9th, when it was 1m. 45s. slow for Greenwich mean time, and losing 2.5s. daily: the interval being nearly 13 days, gives the accumulated rate 32. 2s. The longitude by chron. at the time of the above observations is 12°59′ 15″ W., and the diff of long. to noon 3′ W. being added, places the ship in longitude 13°2′15″ W.

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Saturday, June 23, 1866.
1	4		S. S. W. ½ W.	E. by N.		An increasing breeze throughout, with fair weather and smooth water.
2	4	4				
3	5					
4	5					Stayed the masts, set up the rigging, and rattled it down fore and aft.
5	5					
6	5	2				
7	5	6		Variable.		At 8h. 36m. P. M., when the chronometer shewed 9h. 24m. 56s. P. M., the altitude of the star Aquilæ was observed to be 15° 44′ 40″ *East* of the meridian, the index error being 1′ 10″ + ; making the long. 13° 12′ 0″ W. which, worked back to the *last noon* by the log, gives the longitude 13° 3′ 0″ W.
8	6					
9	6					
10	6	4		S. E. by E.		
11	7					
12	7					
1	7					
2	7					
3	7					In 1st reef of the topsails.
4	8		S. W. by W.	S. E.		At 7h. 10m. A. M. observed as follows :—
5	7					Times by Chron. Obs. alt. Sun's L. L.
6	7	4				20h. 2m. 56s. 27° 30′ 30″
7	7	6	S. W.	S. E. ½ S.		3 50 38 20
8	7	2				4 59 46 40
9	8					which give the long. at noon 14° 2′ 30″ W.
10	8					Obs. mer. alt. of Sun's L. L. 73° 39 11″ S. :
11	7	4				which gives the lat. at noon 39° 35′ 56″ N.
12	7	4				Variation 1¾ point West.

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 17° W.	153′	146′ S.	46′ W.	39° 37′	39° 36′	60′ W.	14° 21′	☽ Chr. 14° 3′	Porto Santo, S. 15½ W. 408m.

The courses being this day corrected for variation with the corresponding distances, will be as in the Traverse Table.

True Courses.	Dist.	N.	S.	E.	W.
S ¾ W.	88		87.0		12.9
S. W. ¾ S.	22		17.7		13.1
S. S. W. ¼ W.	46		41.6		19.7
	Diff. lat.		146.3	Dep.	45.7

The lat. at 8h. 36m. P.M., brought on from the last obs., is 41° 20′ N. The mean time at the ship found by star's altitude is 8h. 34m. 26s.

The diff. of lat. made good between 7h. 10m. A.M. and noon, is 34′ S., which being added to 39° 36′ N., the lat. by obs. at noon, give the lat. 40° 10′ N., when the sights were taken for finding the long. by chron.; these give the long. at that time 13° 41′ 30″ W., to which add the diff. of long. made to noon, *viz.* 21′ W., their sum 14° 2′ 30′ W. will be the long. at noon by chron.

The diff. of lat. 146′.3, and departure 45′.7, give the true course S. 17° W., and the distance 153 miles.

Yes. lat. by obs. 42° 3′ N.   Mer. Parts 2786
Diff. lat. 146′ or 2 26 S.

Lat. in by acc. 39 37 N. (obs.) 39° 36′ M. Pts. 2591
Sum of lats.... 81 40
Middle lat. ... 40 50   Mer. diff. lat. 195
Co. mid. lat.... 49 10

The co. mid. latitude 49° 10′, and the dep 45′.7, give the diff. of longitude 60′.5 ; or th course 17°, and the mer. diff. of lat 195′ give the diff. of long. 60′, or............ 1° 0′ W.
Yesterday's long. by acc. ...... 13 21 W.

Longitude in by account ...... 14 21 W.

To find the Bearing and Distance of Porto Santo.

Lat. of ship by obs. 39° 36′ N.......Mer. Parts ... 2591   Long. of ship by chron. 14° 3′ W.
Lat. of Porto Santo 33 3 N.......Mer. Parts ... 2103   Long. of Porto Santo.. 16 19 W.

Diff. of latitude ... 6 33 = 393′ Mer. diff. lat. 488   Diff. of longitude...... 2 16 = 136′

Hence the true bearing of Porto Santo is S. 15½° W., or S. by W. ¼ W., and the distance 408 miles. The course by compass is S. 36° W. = S. W. ¾ S. nearly

Ship BRITANNIA from England towards Madeira.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Sunday, June 24, 1866.
1	7	4	S. W.	S. E.		A fresh breeze throughout, with passing squalls, and rain at times; latter part fine clear weather. People and tradesmen employed as yesterday. Gunner painting the boats. At 6h. 30m. P.M. the sun's azimuth by compass was N. 50° 18′ W., and the alt. of its L. L 11° 20′ 30″, which, with the latitude 38° 50′ N., give the variation 18° 44′ W. At 8h. 2m. P. M., when the Chronometer shewed 8h. 58m. 32s. P. M, the altitude of star Antares was observed to be 18° 21′ 25″ *East* of meridian, Index error 1′ 10″ + making the long. 14° 36′ 30″ W., which worked back to *last noon* by the log, gives the longitude 14° 1′ 30″ W. At 8h. 0m. A. M. observed as follows :— Times by Chron. — Obs. alt. Sun's L. L. 21h. 0m. 38s. — 37° 5′ 20″ 1 50 — 17 40 3 6 — 30 15 which give the long. at noon 15° 40′ 00″ W. Obs. mer. alt. ⊙'s L. L. 76° 24′ 20″ S., which gives the lat. by obs. at noon 36° 49′ 46″ N.
2	7	6				
3	8					
4	8					
5	8					
6	8					
7	8					
8	8					
9	8					
10	8	4		S. E. by E.		
11	8	2				
12	8					
1	7	4				
2	7	4		S. E.		
3	7					
4	7					
5	7					
6	8					
7	8					
8	8		S. W. ½ W.	S. E. by S.		
9	8					
10	7	6				
11	7	4				
12	7					

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 27° W.	186′	165′ S.	85′ W.	36° 51′	36° 50′	108′ W.	16° 9′	⊙-☾ Chr. 15° 40′	Porto Santo, S. 8° W. 229m.

The courses corrected for variation, per azimuth, to the nearest degree, with the corresponding distances, will be as under.

True Courses.	Dist.	N.	S.	E.	W.
S. 26° W.	148		133.0		64.9
S. 32 W.	38		32.2		20.1
	Diff. lat.		165.2	Dep.	85.0

The lat. by acc. when the sun's azimuth was observed at 6h.30m. P.M., was 38°50′ N.

The lat. by acc. at 8h. 2m. P.M. when the star Antares was observed, was 38° 39′ N.

The lat. by acc. at 8h. 0m. A. M., when the sights were taken for chronometer was 37° 15′ N., and the long. at sight was 15°20′ W., which being brought on to noon by the log., places the ship in long. 15° 40′ W.

The diff. of latitude 165′.2, and the departure 85′.0, give the true course S. 27° W. and, the distance 186 miles.

Yes. lat. by obs. 39° 36′ N. 39° 36′ M. Pts. 2591
Diff. lat. 165′ or 2 45 S.

Lat. in by acc. 36 51 N. (obs.) 36 50 M. Pts. 2380

Sum of lats......... 76 26 M. D. L. 211
Mid. latitude 38 13
Co. mid. latitude 51 47

The co. mid. lat. 51° 47′, and the dep. 85°, give the diff of long. 108m.; or the course 27°, and the mer. diff. of lat. 211′, give the diff. of long. 107.6 miles, or .... 1° 48′ W.
Yesterday's long. by account ...... 14 21 W.

Longitude in by account............ 16 9 W.

To find the Bearing and Distance of Porto Santo.

Lat. of ship by obs. 36° 50′ N..... ...Mer. Parts...2380 Long. of ship by Chro.... 15° 40′ W.
Lat. of Porto Santo 33 3 N.........Mer. Parts...2103 Long. of Porto Santo ... 16 19 W.

Diff. of latitude ... 3 47=227′ Mer. diff. lat. 227 Diff. of Longitude 39

Hence the true course to Porto Santo is S. 8° W. or S. ¾ W. nearly, the magnetic course S. 27° W., and the distance 229 miles.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Leeway.	Remarks, Monday, June 25, 1866:
1	7	4	S. W.	S. S. E.		First part a fresh breeze; middle and latter more moderate, and smooth water.
2	7					
3	7					
4	7					
5	6	6				At 7h. 14m. P. M. the sun set W. 46° 23′ N. by compass, , which gives the variation 16° 55′ W., or. 1½ point.
6	6					
7	6					
8	5					
9	5		W. S. W.	South.	½	At 10h. 6m. P. M. the mer. alt. *Antares, or α Scorpii, was 28° 0′ 41″ S., making the latitude 35° 57′ 17″ N.
10	5					
11	5					
12	4	6	S. E. by E.	S. by W.	1	
1	4	6				
2	5					At 9h. A. M. observed as follows:—
3	4	4				Times by Chron. — Obs. alt. Sun's L.L.
4	4					21h. 59m. 4s. — 48° 10′ 45″
5	4					22 0 26 — 21 15
6	3		West.	S. S. W.	1½	22 1 51 — 31 50
7	3					which give the long. at noon 16°21′ 00″ W.
8	3					
9	3	6				
10	3	2				Obs. mer. alt. ⊙'s L. L. 77° 27′ 6″ S., gives the lat. at noon 35° 45′ 6″ N.
11	3					
12	3					

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 29° W.	65′	57′ S.	32′ W.	35° 53′	35° 46′	44′ W.	16° 53′	⊙-☾ Chr. 16° 21′	Porto Santo, S. 1° E., 163m.

The courses corrected for variation per amplitude at sunset, and for leeway, with their corresponding distances. will be as under.

True Courses.	Dist.	N.	S.	E.	W.
S. S. W. ½ W.	52		45.9		24.5
S. W. by W.	15		8.3		12.5
E. ½ S.	27		2.6	26.9	
West.	22				22.0
	Diff. lat.		56.8	26.9	59.0
					26.9
				Dep.	32.1

The diff. of latitude 56′. 8, and dep. 32′. 1, give the course S. 29° W., and the distance 65 miles.

Yest. lat...36° 50′ N. 36° 50′...Mer. Pts. 2380
Diff. of lat. 57 S.

Lat. by acc. 35 53 N. (obs.) 35 46 ...Mer. Pts. 2301

Sum of latitudes ... 72 36 ...M. D. L. 79
Middle latitude...... 36 18
Co. middle latitude. 53 42.

The lat. at sunset brought up by the log. since last noon, is 36° 7′ N. At 9h. A. M. the lat. by acc. is 35° 46′ N., and the long. by chron. at that time 16° 10′ 0″ W., to which the long. made up to noon, 11′ W., being added, gives the long. by chron. at that time 16° 21′ 0″ W.

The co. mid. lat. 53° 42′, and the dep. 32′. 1, give the diff. of long. 40′; or the course 29°, and the mer. diff. lat. 79′, give the diff. of long. 43′.6 W.: this being added to yesterday's long. by acc. 16° 9′ W., gives the long. by acc. this day, at noon, 16° 53′ W.

To find the Bearing and Distance of Porto Santo.

Lat. of ship by obs. 35° 46′ N. ......Mer. Parts ... 2301 Long. of ship by Chro. 16° 21′ W.
Lat. of Porto Santo 33 3 N. ......Mer. Parts ... 2103 Long. of Porto Santo 16 19 W.

Diff. of latitude. ... 2 43 = 163′ Mer. diff. lat. 198 Diff. of longitude 2

Hence the true bearing is S. 1° E., and the distance 163 miles. The course by compass is therefore S. 16° W., or S. by W. ½ W.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks Tuesday, June 26, 1866.
1	3		West.	S. S. W.	1¼	An increasing breeze, and fair throughout.
2	3					
3	4					P. M. bent the best bower and sheet cables, and unstowed the anchors. People otherwise employed, reeving the harbour-gear, and in sundry small jobs.
4	4	6	S. W. by W.	S. by E	1	
5	5					
6	5					
7	5	4				
8	6		South.	East.		At 8h. P. M. the alt. of the Polar Star was 34° 12′ 45″ which gives the lat. 35° 27′ 53″ N.
9	6					
10	6					
11	6		S. S. E.			
12	6					At 1h. 20m. A. M. the meridian alt. of the * *a* Aquilæ or Altair, was 63° 37′ 36″ S., making the lat. 34° 58′ 13″ N.
1	6	4		E. N. E.		
2	6	6				
3	6	6				
4	7					At 8h. A. M. observed as follows:— Times by Chron. — Obs. alt. Sun's L. L. 21h. 2m. 7s. — 36° 40′ 45″ 3 15 — 48 20 4 23 — 55 45
5	7					
6	7					
7	7			N. E. by E.		
8	7					
9	7	4				which give long. at noon 15° 31′ 30″ W.
10	8					Obs. mer. alt. Sun's L. L. 79° 14′ 35″ S., gives the lat. at noon 33° 56′ 16″ N.
11	8			N. E.		
12	7	4				Variation 1½ point West.

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
S. 21½° E.	113′	106′ S.	42′ E.	34° 0′	33° 56′	53′ E.	16° 0′	○-☾ Car. 15° 32′	Porto Santo, S. W. ¾ S. 65m.

True Courses.	Dist.	N.	S.	E.	W.
West.	10				10.0
S. W. ½ W.	20		12.7		15.5
S. by E. ½ E.	18		17.2	5.2	
S. E. ½ S.	98		75.7	62.2	
	Diff. lat.		105.6	67.4	25.5
				25.5	
			Dep.	41.9	

The diff. of lat. 105′.6, and dep. 41′.9, give the course S. 21½° E., and the distance 113 miles.

Yest. lat. ...... 35° 46′ N. 35° 46′ M. Pts. 2301
Diff. lat. 106′, or 1 46 S.

Lat. by acc.... 34 0 N. (obs.) 33 56 M. Pts. 2167

Sum of latitudes ...... 69 42 M. D. L. 134
Middle latitude 34 51
Co. middle latitude ... 55 9

The comp. of mid. latitude 55° 9′, and the departure 41′.9, give the diff. of long. 51′, or the course 21½°, and the mer. diff. of lat. 134′, give the diff. of longitude 52.9 miles.

Yesterday's long. by account ...	16° 53′ W.	Yesterday's long. by Chron...	16° 21′ W.
Diff. of long. by the log	− 53 E.	Diff. of long. by Chron	− 49 E
Longitude in by account.........	16 0 W.	Long. by Chron. at noon	15 32 W.

To find the Bearing and Distance of Porto Santo.

Lat. of ship by obs....	33° 56′ N.......	Mer. Parts ...	2167	Long. of ship by Chro.	15° 32′ W.
Lat. of Porto Santo...	33 3 N.......	Mer. Parts ...	2103	Long. of Porto Santo..	16 19 W.
Diff. of latitude	53	Mer. diff. lat.	64	Diff. of longitude......	47

Hence the true bearing is S. 36° W. = S. W. ¾ S., and the distance 65 miles. The course by compass is therefore S. W. ¾ W.

SHIP BRITANNIA from ENGLAND towards MADEIRA.

H.	K.	F.	Courses.	Winds.	Lee-way.	Remarks, Wednesday. June 27, 1862.
1	7	2	S. W. by S.	N. E.		A pleasant breeze, and fair throughout.
2	7					P. M. bent the small bower cable, and un-
3	6	4				stowed the anchor.
4	6					
5	5	4	S. W. by W.	E. N. E.		
6	5					Saw the land bearing W. by S.
7	5	2				
8	5					
9	5	2		East.		Porto Santo W. ½ N., about 8 leagues.
10						At 10 P. M. brought to. Main top-sail to
11						the mast.
12			Lying-to.			The High Water in Funchal Roads is found
1						to be at 11h. 39m. P. M.,
2						
3			W. S. W.			At daylight made sail.
4						
5						
6						Porto Santo N.W. by N. Deserters S.W. by S.
7						East end of Madeira W. by S.
8						At noon came to an Anchor in Funchal Roads,
9			W. by S.			with the best bower, in 25 fathoms; mud
10			Various.			and sand; off shore ¼ of a mile; Loo
11						Castle bearing N.N.W., and Fort Lorenzo
12						E. N. E.

Course.	Dist.	Diff. lat.	Dep.	Latitude N.		Diff. long.	Longitude W.		Bearing and Distance at noon.
				Acc.	Obs.		Acc.	Obs.	
								☽ Chr.	

The courses steered from noon to 9h. P. M., and the bearing of Porto Santo from the ship at that time, corrected for 1½ point West variation; also the distances run, and the estimated distance of the ship from the land, being entered in a Traverse Table, will give the diff. of latitude 50′. 6, and the departure 47′. 8.

From hence the latitude of Porto Santo, by the ship's reckoning, is found to be 33° 5′ N., and the longitude, carried on by chronometer from the last lunar observation, 16° 29′ W.; differing 2 miles in latitude and 10 miles in longitude, from its position, as laid down in Table LVI.

The ship's track during the preceding voyage is laid down on the Mercator's Chart, according to the latitude and longitude each day at noon.

ABSTRACT OF THE PRECEDING JOURNAL.

Week Days.	Date.	Winds.	Courses.	Dist.	Lat.byAcc.	Lat.byObs.	Longitude by Account.	Longitude by Lunar and Chronometer.	True Bearings and Distances at Noon.
Friday ……	1866, June 15	E. N. E. N. by W.	S. 37° W.	81′	48° 53′ N.		6° 27′ W.		
Saturday …	16	N. by W. S. S. W.	S. 42° W.	64	48 6	48° 6′ N.	7 31		C. Finisterre, S. 13½° W., 319 miles.
Sunday ……	17	S. S. W. S.	S. 74° W.	75	47 45	47 43	9 19		C. Finisterre, South, 287 miles.
Monday ……	18	S. S. W. W. by S.	S. 7° E.	92	46 11	46 3	9 1		C. Finisterre, S. ¼ W., 187 miles.
Tuesday……	19	West. S. by W.	S. 33° W.	124	44 19	44 19	10 37		C. Finisterre, S. 35° E., 101.5 miles.
Wednesday..	20	Variable.	S. W.	41	43 50		11 17		C. Finisterre, S. E. by E. ¼ E., 105 miles.
Thursday …	21	S. S. W. S. E. by S.	S. 46° W.	103	42 38	42 38	13 0		Porto Santo, S. 15° W., 596 miles.
Friday ……	22	Variable.	S. 24° W.	35	42 6	42 3	13 21	☽ Chr. 13° 2′ W.	Porto Santo, S. 16° W., 562 miles.
Saturday …	23	Variable.	S. 17° W.	153	39 37	39 36	14 21	☽ Chr. 14 3′	Porto Santo, S. 15½° W., 408 miles.
Sunday ……	24	S. E.	S. 27° W.	186	36 51	36 50	16 9	☽ Chr. 15 40	Porto Santo, S. 8° W., 229 miles.
Monday ……	25	S. S. E. S. S. W.	S. 29° W.	65	35 53	35 46	16 53	☽ Chr. 16 21	Porto Santo, S 1° E., 163 miles.
Tuesday……	26	S. S. W. N Easterly.	S. 21½° E.	113	34 0	33 56	16 0	☽ Chr. 15 32	Porto Santo, S. W. ¾ S ., 65 miles.
Wednesday..	27	N. E. East.							Anchored in Funchal Roads.

H.	K.	F.	Courses.	Winds.	Leeway.	Signals.	Remarks, &c. Saturday, April 7, 1866.
1	3	6	N. W.	N. N. E.	½		A. M.
2	2	6					First and middle parts light variable winds, and cloudy weather; latter part moderate and fair.
3	2	6					
4	2		W. N. W.	North.	¼		
5	3	4					
6	5		N. by W.	Variable.			A. M. stayed the masts, set the rigging up, and rattled it down fore and aft.
7	4	2		Light Airs.			
8	1						
9		4					At noon a strange sail in sight, bearing N. W. by W.
10				Calm.			
11							
12	1	4	E. N. E.	West.			Variation 2 Points West.

Course.	Dist.	Latitude.		Longitude.			Bearing and Dist. at Noon.
		By D. R.	By Obs.	By D. R.	By Chr.	By L. Obs.	
N. 26° W.	57′	48° 17′ N.	48° 20′ N.	9° 4′ W.	9° 15′ W.	9° 22′ W.	Lizard, N. E. by E. 191m.

1	1	6	E. by N.	West.			P. M.
2	2	2					
3	3	4					At 4h. P. M. a suspicious looking vessel in sight, right a-head. Made all possible sail in chase of her: then mustered the ship's company to their quarters, and prepared for action.
4	3	6					
5	5	2					
6	5	4					
7	5	4	E. by S.	W. N. W.			
8	5	4					
9	5	4					At midnight spoke the chase. She proved to be a Spanish brig from Teneriffe, bound to Corunna.
10	6						
11	6	2					
12	6	2					

H.	K.	F.	Courses.	Winds.	Leeway.	Signals.	Remarks, &c Sunday, April 8, 1866.
1	6		E. by S.	W. N. W.			A. M.
2	6						First part moderate breeze, and smooth water; middle and latter, light variable airs, with drizzling rain.
3	5	4					
4	5	4					
5	5	4					
6	4	2					
7	4	2					
8	4		East.	N. W.			
9	4						Exercised great guns and small arms.
10	3	6					
11	3	2					
12	3			Variable.			Variation 2 Points West.

Course.	Dist.	Latitude.		Longitude.			Bearing and Dist. at Noon.
		By D. R.	By Obs.	By D. R.	By Chr.	By L. Obs.	
N. 72½° E.	110′	48° 53′ N.	48° 55′ N.	6° 24′ W.	6° 33′ W.	6° 40′ W.	Lizard, N. 43° E. 86m.

SHIP ——— from ENGLAND towards CEYLON.

H.	Courses.	K.	F.	Winds, &c.	Leeway.	Wednesday. August 15, 1866.
1	S. W.	2		S. S. E.	1	Moderate breezes, and pleasant weather throughout.
2		2	4			
3		3	2			A. M. stayed the masts, and set up the main and main-top-mast rigging.
4		3	2			
5		3	4			
6		4				Tradesmen variously employed.
7		2	4			
8		3				
9		3				
10		3				
11		3				
12		3				
1		3	6			
2		3	6			
3		2				
4		2	6			
5	W. S. W.	3	6	S. by E.		
6		4				
7		3	6			
8		3	6			
9		2				Latitude observed 2° 0′ N.
10		2				
11		2				
12		2				
	Dist. per log.	72m.		11 Inches in the Well.		

Course and dist. S. 50° W. 70m. | X Lat. {obs. 58, acc. 46 | X Lon. {acc. 54, chr. 82 | Lat. {obs. 2° 0 N., acc. 2 12 N. | Lon. {mde., in. 21° 41′ {☾, chr. 20° 12′ W. | var. {pm., am. 10° W.

Departure 54 | S. of acc. 12. | W of acc. 28 | Barom. 29.5 | Therm. 78°. |

H.	Courses.	K.	F.	Winds, &c.	Leeway.	Thursday, August 16, 1866.
1	S. W.	4		S. S. E.	½	A steady breeze, and fine weather throughout.
2	W. S. W.	4	4			
3		4				A. M. set up the mizen rigging.
4		4				Washed the gun-deck, and exercised great guns and small arms.
5	S. W.	4			½	
6		4				
7		2	6			Longitude per Sun and Moon at 11h. A. M., 22° 8′ W. of Greenwich.
8		2	4			
9		2	2			
10		2				
11		2	6			
12		3				
1		3				
2		2	6			
3		3				
4		3				
5		3				
6	W. S. W.	3		South	½	
7		4	6			
8		4	6			Latitude observed 0° 56′ N.
9		3	6			
10		3	4			A strong set to the westward.
11	S. S. W.	3	4	S. E.	½	
12		3	2			
	Dist. per log.	82m.		10 Inches in the Well.		

Course and dist. S. 47° W. 79m. | X Lat. {obs. 64, acc. 54 | X Lon. {acc. 58, ch. 113 | Lat. {obs. 0° 56 N., acc. 1 6 N. | Lon. {mde., in. 22° 39′} ☾ 22° 9′ W., chr. 22 5 | var. {pm., am. 10° W.

Departure 58 | S. of acc. 10. | W. of acc. 55 | Barom. 29.6. | Therm. 78° |

ON THE VARIATION OF THE COMPASS;

ALSO,

THE DIP AND DEVIATION OF THE NEEDLE.

The mariner's compass (which is familiarly called, and universally admitted to be, the *seaman's friend*), has, it is well known, various properties connected with it; the principal of which are those coming under the denomination of *variation of the compass*, *dip of the needle*, and *deviation;* each of which subjects, every commander and officer should pride himself to become acquainted with, and will here be *very briefly* explained.

Variation of the Compass.—In the year 1492, Columbus discovered that his compass needle deviated from the *true* North and South points of the horizon, and when satisfactorily proved to be the case, by careful observations, it very naturally (on such a discovery) caused considerable alarm in the minds of his crew—who even mutinied, affirming and believing that the compass had lost its polarity; and hence, that they would never be able to return to Spain: but it is recorded, that Columbus had the tact to calm their fears on this subject, and thereby confidence, in his superior judgment and assurances, was soon restored.

When Columbus returned to Spain, on comparing his compasses with those that had never been afloat, and finding that they perfectly agreed, he had the boldness to assert, "that *every compass* varied in its direction *from the true* North and South points of the horizon; which assertion was not only disbelieved, but he was laughed to scorn for declaring the same by every Astronomer of his day, without investigating (as they might have done) as to the truth or falsehood of his assertion: such was the intolerant spirit of the times when Columbus lived, and continued for many years after; it was therefore most dangerous at that period for men to meddle with doctrines or opinions on any science or profession not sanctioned or approved of by the priests. Hence, the subject remained *statu quo* for many years, until again renewed and declared about the year

1556 by Martin Cortez, who, in his Treatise on Navigation and Nautical Astronomy, printed at Seville, asserts, "the variation of the compass as being *completely established:*[*] since which period, it has been admitted and proved, as an acknowledged fact, by Astronomers of every age and nation; thereby further shewing, by accurate observations made in various parts of the world, that in different places the variation of the compass differs, both as to its quantity and denomination, being West in some places, and East in others; and as the amount is *constantly varying*, it becomes manifest as to the necessity of frequent observations being made, to determine the same, by either amplitudes or azimuths, in accordance with the rules given in pages 210, 212, and 213 of this work.

DIP OF THE NEEDLE.—In addition to the variation of the compass from the plane of the true meridian, it obtains another property, caused by an angle which the needle makes with the horizon, and therefore termed the *dip of the needle.*

This was discovered about the year 1580, by an Englishman, named Robert Norman; he found, notwithstanding the needle was properly balanced beforehand, it had a tendency from its horizontal position, the North point of the needle being depressed in the Northern hemisphere, and the South end in the Southern hemisphere; but at the magnetic equator (with a very few minor exceptions) the horizontal position was nearly retained. The deviation of the compass, from the horizontal line, is different in different places, like the variation, and undergoes very slow changes.

This property which the needle has, does not, fortunately, (notwithstanding the amount of dip) appear to affect or derange its horizontal movement; nor does it affect, or have any influence whatever on the variation of the compass.

It is generally considered, among seamen, that the dip of the needle varies with the latitude; that is, the dip is North in the Northern hemisphere, South in the Southern, and becomes horizontal at the *earth's equator;*[†] neither of which is really so, as may be seen by many discrepancies of such a notion, in the following Table of Dips—to which is annexed the latitudes and longitudes of the places stated below.

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[*] *Vide* article Variation. Encyclopædia Britannica.

[†] As there are *two poles* (that belonging to the earth, and a magnetic pole), hence there must also be *two equators*, the earth's, and magnetic equator; consequently it is the *latter* the dip of the needle is reckoned from, which accounts for the *apparent* discrepancies as some imagine.—*Vide* the following Table.

A TABLE *of the Magnetic Dip, at the undermentioned Places, extracted from the best modern Authorities, being the result of recent observations.*

PLACES.	Lat.	Long.	Dip.	PLACES.	Lat.	Long.	Dip.
	° ′	° ′	° ′		° ′	° ′	° ′
London	51 32 N.	0	69 20 N.	Fernando Po ..	3 14 N.	8 25 E.	0 48 N.
Plymouth	50 22 N.	4 8 W.	69 12 N.	Pulo Penang ..	5 25 N.	100 22 E.	4 40 S.
Rotterdam	51 55 N.	4 29 E.	68 49 N.	Callao	12 4 S.	77 4 W.	6 14 S.
Paris	48 50 N.	2 20 E.	67 20 N.	Rio Janeiro	22 53 S.	43 15 W.	12 54 S.
Petersburg	59 56 N.	30 18 E.	70 5 N.	Singapore......	1 17 S.	103 50 E.	12 1 S.
Terceira	38 39 N.	27 13 W.	68 6 N.	Martin's Isles..	11 3 S.	77 30 W.	14 6 S.
Rome..........	41 51 N.	12 30 E.	60 24 N.	St. Helena	15 55 S.	5 45 W.	18 1 S.
Naples	40 50 N.	14 16 E.	58 53 N.	Borneo	4 55 N.	114 52 E.	19 48 S.
Constantinople..	41 1 N.	28 55 E.	56 34 N.	Amboyna	3 40 S.	128 15 E.	21 9 S.
Bermuda	32 22 N.	64 38 W.	67 31 N.	St. Catherina ..	27 19 S.	47 50 W.	21 40 S.
Montreal	50 28 N.	1 45 E.	76 19 N.	Monte Video ..	34 55 S.	56 16 W.	34 51 S.
Halifax	50 53 N.	0 54 W.	74 45 N.	Valparaiso	33 1 S.	71 38 W.	38 3 S.
New York......	40 42 N.	73 59 W.	72 52 N.	Conception	36 49 S.	73 5 W.	43 15 S.
Washington....	38 55 N.	76 59 W.	71 21 N.	Chiloe	42 41 S.	74 10 W.	48 59 S.
Antigua........	19 20 N.	96 14 W.	48 46 N.	Port Desire	47 45 S.	66 2 W.	51 20 S.
Jamaica	18 0 N.	76 46 W.	47 19 N.	Falkland Island.	41 15 S.	72 45 W.	53 20 S.
Alexandria	31 13 N.	29 55 W.	43 48 N.	R. Santa Cruz..	50 19 S.	68 29 W.	55 15 S.
C. San Blas	29 36 N.	85 35 W.	45 23 N.	C. Good Hope ..	34 24 S.	18 24 E.	52 54 S.
San Francisco Pt.	37 49 N.	122 8 W.	62 28 N.	Simon's Bay....	34 10 S.	18 10 E.	35 4 S.
Vancouvre	50 0 N.	126 0 W.	69 22 N.	Seychelles	4 35 S.	55 31 E.	32 5 S.
Sitka	57 10 N.	134 50 W.	75 51 N.	Raratonga Isl...	20 20 S.	170 30 W.	36 8 S.
Chagre	9 20 N.	80 3 W.	32 30 N.	Macassar Island.	5 9 S.	119 36 E.	23 42 S.
Panama City ..	8 59 N.	79 20 W.	31 55 N.	Tahiti	17 29 S.	149 30 W.	30 17 S.
Hong Kong	22 12 N.	114 12 E.	30 2 N.	Bass' Straits ..	39 14 S.	143 30 E.	69 8 S.
Acapulco	16 50 N.	99 51 W.	39 3 N.	Swan River	40 17 S.	156 10 E.	62 24 S.
San Diego	32 40 N.	117 17 W.	57 6 N.	Sydney	33 48 S.	151 23 E.	62 49 S.
Manilla........	14 36 N.	121 3 E.	16 27 N.	Hobart Town ..	42 53 S.	147 25 E.	70 40 S.
Pernambuco....	8 4 S.	34 54 W.	13 8 N.	Auckland Island.	50 44 S.	165 0 E.	73 10 S.
Cocos Islands ..	5 27 N.	87 45 W.	24 36 N.	Kerguelens Isl...	48 41 S.	69 4 E.	69 50 S.
Guayaquil......	2 12 S.	79 54 W.	9 8 N.	Bow Island	18 17 S.	140 43 W.	30 15 S.
Bahia, F. Cabo.	12 58 S.	38 13 W	5 24 N.	Majombo Island.	15 10 S.	47 6 E.	48 18 S.
Ascension	5 57 S.	14 14 W.	1 39 N.				

NOTE.—The above Table of *dips* have been extracted for Captain W. Walker's excellent Treatise on the Magnetism of Ships, and the Mariner's Compass. *Vide* page 39; to which Table has been attached the Latitudes and Longitudes as above shewn, to verify the preceding statement.

Deviation of the Needle.—This peculiar property attending the magnetic needle, has been noticed and commented upon, during many years past, by intelligent mariners, skilful officers, astronomers, and others, and notwithstanding the subject of deviation has been so clearly proved and elucidated from time to time by so many learned and able men—shewing its dangerous effects to the practical navigator if not attended to; —yet, strange to say, very little heed has been taken about the matter, or even accounted for, till of *very recent date;* and notwithstanding the subject is a comprehensive one, it is only intended to touch upon it here *very briefly.* Those who wish to gain full information upon the same (being of such vital importance to all navigators), are warmly recommended to possess themselves of an excellent Treatise, written in a very clear and intelligible manner, by Captain William Walker, R. N., by the study of which, seamen will be greatly benefitted. It is now intended briefly to explain what the deviation is, how it is determined, and in what manner applied.

1. *First.—The deviation is* caused by the reciprocal action of the compasses upon each other, when (as is too frequently the case) the binnacles are placed *too near each other.*[*]

Secondly.—By the aggregate influence of the ship's iron upon the magnetic needle, according to the direction of the ship's head diverging from the North or South points of the compass; hence it is earnestly recommended that no iron-work, such as ring-bolts, shot, arms, belaying pins, iron stanchions above or below, &c., should be nearer the vicinity of the compasses than *seven feet*, if it can be possibly avoided.

Thirdly.—The imperfection of the compasses themselves, as regards the magnetism of their needles; the imperfection of their caps, pivots, bowls, and insufficient suspension, &c.

Fourthly.—It is therefore self evident, that the deviations in any ship will be the resultant of all the magnetic forces of the guns, bolts, bars, tanks, anchors, chain cables, &c., acting on the compasses in its place on each course steered; and these agencies not only change in direction and amount, as the ship changes her position, but they alter with every *motion* and *roll* of the ship.

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[*] The Lords of the Admiralty have issued orders, that the binnacle compasses are on no account to be nearer than *five feet* of each other.

2. *How the deviation may be determined.*—Every ship should be provided with a good *standard compass* (say the azimuth compass, with a brass rim marked to degrees, should there be one on board) with which the binnacle compasses ought to be frequently compared, and by which all bearings should be taken.

The standard compass should be placed on the midship line of the quarter-deck, and fixed on a permanent support, or pillar, or on a tripod stand, made to ship and unship, for greater convenience, taking care it is at such a sufficient height from the deck, as to allow of all amplitudes, azimuths, and bearings of the land, &c., being observed *above* the hammock boards, or sides of the vessel.

The deviation of the standard compass from the magnetic meridian is to be ascertained in the following manner:—if the ship is in a basin, it can be executed at any time, but if riding in a tide-way, it can only be ascertained when it is slack water.

* "Prudence and precaution require that mariners should use all available means for determining the errors of their compasses at sea, or in an anchorage, and as these means are generally attainable, we shall notice some of them.

"Whenever a ship anchors in a place where some fixed object is easily seen at a distance of eight or ten miles, its compass bearing should be noted, as well as the direction of the ship's head. Write down the points of the compass on a slate, and as the ship swings by wind or tide, or warped round from one point to another, write down the compass bearing of the distant object, opposite to the direction of the ship's head.

"If the compass be in error, the bearings of the distant object will vary, as the ship swings from point to point, and their difference will ultimately give the amount of deviation. As the ship swings round, there will be two nearly opposite points of the compass on which the bearings of the distant objects agree; and this *should* be the correct magnetic bearing of the object, and the points upon which there is no compass error. Two other points will be found in a table so filled up, and nearly opposite points, where the bearings of the distant object greatly differ; *half their*

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* As Captain William Walker, R. N., in his admirable Treatise on "The Magnetism of Ships, and the Mariner's Compass," is so clear and intelligible on the subject under consideration, his statement upon it, is here puposely quoted, for the benefit of seamen (see pages 163 and 164 of that excellent work); a work, in fact, that should be in the possession of every intelligent and right-minded mariner.

difference will be the deviation on these points: and it will be easily seen if Easterly or Westerly.

"A record of this kind is easily made, and a means is found of forming a *table of deviations* for that amount of magnetic dip or locality.

"This is an easy and pretty correct way of finding a ship's compass deviations at anchor, when a ship is supplied with a proper compass for the purpose. The true bearing of a distant object may be found by measuring with a quadrant or sextant its angular distance with the rising or setting sun. The sun's correct bearing, at rising or setting, is at once obtained from a table of amplitudes, and hence the true bearing of any visible object is easily found.

"When a ship is at sea, we have shewn that, in amplitude and azimuth calculations, the variation and deviation are involved. When the sun is on the meridian, he bears *true* North or South, and a compass bearing of him at that time, will give the variation and deviation combined, and, consequently, the *correction* for the ship's course at that time.

"In taking a sight for the chronometer, the sun's compass bearing should be noted; as the *sight* might be used for finding the *hour angle*, the *azimuth*, or for a *double altitude*.

"In our hemisphere, the Polar Star bears *nearly* due North; and its compass bearing will therefore give the variation and deviations (if any) combined.

"There is another method whereby we may easily find out, at sea, if our binnacle compasses be in error. In beating to windward, with Northerly or Southerly winds, it sometimes appears that the ship, after tacking, must either have been off the wind, or else a change of wind has taken place, while in the act of going about; and on other occasions, in working to windward, the ship lays six points from the wind on one tack, and *only* five on the other: all this indicates compass deviation. The wind has *not* changed; it was the compass pointing that changed, as the ship tacked from West to East."

How the deviation is applied.—The application of deviation of the needle is precisely the same as variation; that is, Easterly deviation to the right hand, and Westerly to the left. When the courses are corrected, the deviation is to be applied *before the leeway or variation.*

Having endeavoured briefly to explain the preceding subjects, it only remains to shew, in a concise and intelligible manner, how seamen are to proceed, to obtain the deviation of the standard compass, elucidating the same by means of supposed bearings of a distant object by the standard at each point of the compass; seamen must ever bear in mind that the corrections found for the standard compass, belongs to *that compass alone*, and to that compass only, while it remains in its fixed and proper place; also, that the corrections obtained by it, will be no guide whatever to the effects of the ship's iron on the standard, if *removed* to any other part of the ship. And it is essential, therefore, that the ship's course should *invariably be directed* by the standard compass; also, that bearings and courses inserted in the log-book, should be those shewn by that compass alone.

Before ascertaining the deviation of the standard compass, the *real magnetic bearing* of a distant object must first be determined, which is readily obtained, by taking the standard on shore, and whatever the bearing of the distant object may be, shews the real magnetic bearing required. Hence it follows, the differences between this real magnetic bearing of the object, and the successive bearings which are observed with the standard compass on board; according to the direction of the ship's head will be the *deviation*, which is further elucidated in the following Table.

Suppose the real magnetic bearing of a distant Obelisk from the ship to be N. 83° E.

Ship's Head by the Standard Compass.	Bearing of Obelisk by the Standard Compass	Deviation by the Standard Compass.	Ship's Head by the Standard Compass.	Bearing of Obelisk by the Standard Compass	Deviation by the Standard Compass.
	° ′	° ′		° ′	° ′
North.	N. 83 11 E.	0 11 W.	South.	N. 82 52 E.	0 8 E.
N. by E.	N. 82 7 E.	0 53 E.	S. by W.	N. 83 55 E.	0 55 W.
N. N. E.	N. 81 20 E.	1 40 E.	S. S. W.	N. 84 38 E.	1 38 W.
N. E. by N.	N. 80 23 E.	2 37 E.	S. W. by S.	N. 85 24 E.	2 24 W.
N. E.	N. 79 23 E.	3 37 E.	S. W.	N. 86 8 E.	3 8 W.
N. E. by E.	N. 78 33 E.	4 27 E.	S. W. by W.	N. 86 50 E.	3 50 W.
E. N. E.	N. 77 38 E.	5 22 E.	W. S. W.	N. 87 39 E.	4 39 W.
E. by N.	N. 77 10 E.	5 50 E	W. by S.	N. 88 17 E.	5 17 W.
East.	N. 77 38 E.	5 22 E.	West.	N. 88 55 E.	5 55 W.
E. by S.	N. 78 3 E.	4 57 E.	W. by N.	N. 88 35 E.	5 35 W.
E. S. E.	N. 78 26 E.	4 34 E.	W. N. W.	N. 88 8 E.	5 8 W.
S. E. by E.	N. 79 20 E.	3 40 E.	N. W. by W.	N. 87 39 E.	4 39 W.
S. E.	N. 79 51 E.	3 9 E.	N. W.	N. 86 56 E.	3 56 W.
S. E. by S.	N. 80 30 E.	2 30 E.	N. W. by N.	N. 86 9 E.	3 9 W.
S. S. E.	N. 81 18 E.	1 42 E.	N. N. W.	N. 85 31 E.	2 31 W.
S. by E.	N. 82 9 E.	0 51 E.	N. by W.	N. 84 35 E.	1 35 W.

The following TABLE, shews the DEVIATION of the COMPASS on board Her Majesty's Ship VESUVIUS.

(*Caused by the local attraction of the ship, at each direction of the ship's head.*)

Direction of the Ship's Head.	Deviation of the Compass.	Direction of the Ship's Head.	Deviation of the Compass.
	° ′		° ′
North.	2 45 E.	South.	3 0 W.
N. by E.	4 57 E.	S. by W.	4 20 W.
N. N. E.	7 30 E.	S. S. W.	5 0 W.
N. E. by N.	9 0 E.	S. W. by S.	6 7 W.
N. E.	10 0 E.	S. W.	7 0 W.
N. E. by E.	10 55 E.	S. W. by W.	7 27 W.
E. N. E.	10 40 E.	W. S. W.	7 50 W.
E. by N.	9 55 E.	W. by S.	8 20 W.
East.	8 50 E.	West.	8 50 W.
E. by S.	7 15 E.	W. by N.	8 10 W.
E. S. E.	5 35 E.	W. N. W.	6 50 W.
S. E. by E.	3 40 E.	N. W. by W.	5 40 W.
S. E.	1 50 E.	N. W.	4 50 W.
S. E. by S.	0 20 E.	N. W. by N.	3 20 W.
S. S. E.	0 56 W.	N. N. W.	1 40 W.
S. by E.	2 20 W.	N. by W.	1 10 E.

We now proceed from the above Table to correct the following Courses for Deviation; by applying Easterly to the right hand, and Westerly to to the left.

Courses Steered.	Deviation from above.	Corrected Courses.	Courses Steered.	Deviation from above.	Corrected Courses.
	° ′	° ′		° ′	° ′
N. E. by E.	10 55 E.	N. 67 10 E.	West.	8 50 W.	S. 81 10 W.
W. S. W.	7 50 W.	S. 59 40 W.	E. N. E.	10 40 E.	N. 78 10 E.
S. E. ½ E.	2 45 E.	S. 47 52½E.	S. W. ½ W.	7 13½W.	S. 43 24 W.
W. by N.	8 10 W.	N. 86 55 W.	N. by W.	1 10 E.	N. 10 5 W.
South.	3 0 W.	S. 3 0 E.	E. by N.	9 55 E.	N. 88 40 E.
N. N. E. ½ E.	8 15 E.	N. 36 22 E.	N. ½ E.	3 51 E.	N. 9 28½E.
S. W. by S.	6 7 W.	S. 27 38 W.	S. S. W.	5 0 W	S. 17 30 W.
E. S. E.	5 35 E.	S. 61 55 E.	S. S. E.	0 56 W	S. 23 26 E.
N. W. ½ W.	5 15 W.	N. 55 52½W.	North.	2 45 E.	N. 2 45 E.
East.	8 50 E.	S. 81 10 E.	W. by S. ½ S.	8 5 W.	S. 65 2½W.

From the preceding Table, it is manifest as to the necessity of applying the deviation of the compass, according to the direction of the ship's head; but it must be remembered, to correct the courses steered for the deviation of the needle, *before* the lee-way or variation

A PAPER,

(BY CAPT. H. TOYNBEE, F.R.A.S.,)

SHEWING HOW LUNARS WILL RATE CHRONOMETERS;

THEREBY

GIVING THE LONGITUDE CORRECTLY DURING AN ABSENCE OF THREE YEARS FROM THE LAND.

Reprinted from the Nautical Magazine.

In sending another paper on lunars to the *Nautical Magazine*, my object is not to bolster up a tottering subject, which the advancement of science causes to be no more requisite, but to maintain the fact that lunars are the only method for finding the longitude, available at sea, independent of delicate machinery so liable to suffer from a stroke of the sea, changes of climate, or the effect of iron, as is the chronometer. It may be considered that lunars are to chronometers what the mercurial barometer is to the aneroid or sympiesometer, i.e., a natural standard with which they ought to be constantly compared; to prove which, let us consider the following quotation from a letter by Captain Shaw, of the *Clive*.

" *Clive*, *Madras*, *July* 8*th*, 1859.—While writing, I cannot refrain from expressing to you the comfort and pleasure I have experienced from that valuable piece of navigation that I learnt from you,—the method of rating chronometers by lunars. I have always followed it up since leaving you, and with the greatest success. I have two indifferent chronometers, but am glad to say that during my command of the *Clive* we have always made the land with the greatest accuracy. This passage out was a more striking example than any other; for although I consider myself a very indifferent observer, there being such a wide difference in the results of my observations East and West of ☾, and several times on the passage out when the sun was in distance I had not an opportunity of getting any sights, still we found the chronometers were altering their rates most considerably; one by the time we had rounded the Cape having changed from losing 3. 3s. daily to losing 7. 8s., and the other from gaining 3. 5s. daily to gaining 1. 0s.; having checked them every opportunity when lunars could be obtained, we stood in to make the Sadras Hills, and spoke a ship from Madras the same morning. You may imagine how pleased I was to find that when he showed me his longitude we agreed to a mile. And an hour afterwards we sighted the Sadras Hills. The last land we had seen was the Lizard Point, on February 19th. How any man can doubt this method I cannot conceive, for I always use my lunar rates with the greatest confidence."

I received a similar letter from Captain Quihampton of the *Tudor*, and the results of his observations were published in the *Notices of the Astronomical Society* for January 12th, 1855.*

In remarking on my paper the Editor says:—

"It is to be feared that, partly from the practical difficulty attending lunar observations, and partly from the extended use of chronometers in navigation, this excellent and independent method of finding the longitude is going out of use. Yet in long voyages it must always be dangerous to rely solely on chronometers, unless they are numerous and have been rated *with reference to the temperature*, which is not the practice of private raters. Even then there are so many causes which may operate to change the rates of chronometers at sea, that a conscientious officer ought never to risk his ship and the lives of his crew upon the going of his chronometers, without the additional check and security which he derives from lunars."

In spite of all this it is to be feared that lunars are dying out, with no natural method for finding the longitude at sea to take their places, and this at a time when it has been proved that any ordinary lunarian may rate his chronometers by them for sea-service better than by any other method: for if the plan be followed out which is shown forth in the following paper, and more fully, though rather differently, explained in a pamphlet published by Wilson, late Norie & Wilson, the most ordinary lunarian may succeed; for not only does the method destroy any constant error in the observer's eye, but also in the sextant used.

What follows is copied from the log kept for the Board of Trade during our last voyage from September, 1858, to August 1859.

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* Previous communications on this subject will be found in the Monthly Notices, Vol. ix., No. 7., and Vol. xiv., pp. 19 and 243.

	No. 1690. *Slow of G.M.T.* m. s.	No. 1759. *Fast of G.M.T.* m. s.
Oct. 2nd.—The mean of four sets of ⊙ E. ☾ lunars gave the following errors for the chronometers	2 6.0	3 25.5
The maker's errors brought on by the maker's rates were	1 11.5	3 24.0

Hence the ⊙ E. ☾ * lunars are 54. 5s. or 13¾′ W. of 1690 and 1.5s. or ½′ E. of 1759.

Oct. 15th.—The mean of six sets of ✱ E. and W. of ☾ lunars taken during four days gave the following errors	5 3.6	1 48.0
The maker's errors brought on by the maker's rates were	1 27 7	4 5.2

Hence these ✱ E. and W. of ☾ lunars are 3m. 36s. or 54′ W. of 1690 and 2m. 17s. or 34¼′ W. of 1759.

Oct. 17th.—The mean of two sets of ⊙ W. ☾ lunars gave the following errors for the chronometers	4 41.5	2 21.6
These errors meaned with the ⊙ E. ☾ errors found Oct. 2nd, give the following errors on Oct. 10th	3 23.8	3 53.6
Oct. 10th.—The maker's errors brought on by the maker's rates were	1 21.2	3 48.7

Hence the mean of these ⊙ E. and W. ☾ lunars is 2m. 2. 6s. or 30¾′ W. of 1690 and 55s. or 13¾ W. of 1759.

Oct. 27th.—The mean of two sets of ⊙ E. ☾ lunars gave the following errors for the chronometers	4 5.0	4 5.6
These errors compared with the ⊙ E. ☾ errors Oct. 2nd give the following rates to the chronometers	0 4.9 losing.	0 1.6 gaining.
These errors meaned with the ⊙ W. ☾ errors found Oct. 17th, give the following errors on Oct. 22nd	4 23.3	3 13.6
Oct. 22nd.—The maker's errors and rates were	1 36.8	4 28.3
	0 1.3 losing.	0 3.3 gaining.

Hence the mean of these ⊙ E. and W. ☾ lunars is 2m. 46.5s. or 41¾′ W. of 1690, and 1m. 15s. or 18¾′ W. of 1759.

And these ⊙ E. ☾ rates differ from those supplied by the maker thus:—

1690 losing 3.6s. more daily. 1759 gaining 1.7s. less daily.

Nov. 11th.—The mean of four sets of ⊙ W. ☾ lunars gave the following rates for the chronometers	7 46.3	2 10.9
These errors compared with the ⊙ W. ☾ errors found Oct. 17th give the following rates to the chronometers	0 7.4 losing.	0 0.5 losing.

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* It will be noticed that these results are deduced from ⊙ E. ☾ lunars only, so that but little confidence can be placed in them.

	No. 1690. *Slow of G.M.T.* m. s.	No. 1759. *Fast of G:M.T.* m. s.
These errors meaned with the ⊙ E. ☾ errors found Oct. 27th give the following errors on Nov. 4th	5 55.7	3 8.3
Nov. 4th.—The maker's errors and rates were...	1 53.7	5 11.2
	0 1.3 losing.	0 3.3 gaining.

Hence the mean of these ⊙ E. and W. of ☾ lunars is4m. 2s. or 60½′ W. of 1690, and 2m. 3s. or 30¾′ W. of 1759.

And these ⊙ W. ☾ rates differ from those supplied by the maker thus :—

1690 losing 6.1s. more daily. 1759 gaining 3.8s. less daily.

Note.—In several of the above instances only two sets of lunars form a series, so that great dependance cannot be placed on their results. Still the whole prove that 1690 is losing more and 1759 gaining less than the rates supplied by the maker. Hence we must be West of the position in which his errors place us.

Dec. 1st.—The mean of six sets of ⊙ E. ☾ lunars gave the following errors for the chronometers	7 50.7	4 50.0
These errors compared with the ⊙ E. ☾ found Oct. 27th give the following rates to the chronometers	0 6.4 losing.	0 1.3 gaining.
These errors meaned with the ⊙ W. ☾ errors found Nov. 11th give the following errors Nov. 21st	7 48.5	3 50.5
Nov. 21st.—The maker's errors and rates were...	2 15.8	6 7.3
	0 1.3 osing.	0 3.3 gaining.

Hence the mean of these ⊙ E. and W. of ☾ lunars is 5m. 32.7s. or 83¼′ W. of 1690. and 2m. 16.8s. or 34¼′ W. of 1759.

And these ⊙ E. ☾ rates differ from those supplied by the maker thus :—

1690 losing 5.1s. more daily. 1759 gaining 2.0s. less daily.

Dec. 12th.—The mean of six sets of ⊙ W. ☾ lunars gave the following errors for the chronometers	11 7.2	3 32.6
These errors compared with the ⊙ W. ☾ errors found Nov. 11th give the following rates to the chronometers	0 6.5 losing.	0 2.7 gaining.
These errors meaned with the ⊙ E. ☾ errors found Dec. 1st give the following errors on Dec. 7th	9 32.3	4 12.6
Dec. 7th.—The maker's errors and rates were ...	2 36.6	7 0.1
	0 1.3 losing.	0 3.3 gaining.

Hence the mean of these ⊙ E. and W. of ☾ lunars is 6m. 55.7s. or 104′ W. of 1690. and 2m. 47.5s. or 42′ W. of 1759.

And these ⊙ W. ☾ rates differ from those supplied by the maker thus :—

1690 losing 5.2s. more daily. 1759 gaining 0.6s. less daily.

Note.—These last errors and rates are deserving of great confidence because they are deduced from two series of six and one series of four sets of lunars.

	No. 1690. *Slow of G.M.T.* m. s.	No. 1759. *Fast of G.M.T.* m. s.
Dec. 15*th*.—The mean of six sets of ✱ E. and W. of ☾ lunars gave the following errors for the chronometers	11 13.6	4 9.6
These errors compared with the ✱ E. and W. of ☾ errors found Oct. 15th give the following rates to the chronometers	0 6.2 losing.	0 2.4 gaining.
Dec. 15*th*.—The maker's errors and rates were	2 47.0	7 26.5
	0 1.3 losing.	0 3.3 gaining.

Hence these ✱ E. & W. of ☾ lunars are 8m. 27s. or 127′ W. of 1690, and 3m. 17s. or 49¼′ W. of 1759.

And these ✱ E. and W. of ☾ rates differ from those supplied by the maker thus :—

1690 losing 4. 9s. more daily. 1759 gaining 0. 9s. less daily.

	No. 1690.	No. 1759.
Dec. 26*th*.—The mean of five sets of ⊙ E. ☾ lunars gave the following errors for the chronometers	13 16.6	4 51.8
These errors compared with the ⊙ E. ☾ errors found Dec. 1st give the following rates to the chronometers	0 12.9 losing.	0 0.1 gaining.
These errors meaned with the ⊙ W. ☾ errors found Dec. 12th give the following errors on Dec. 19th	12 12.0	4 12.4
Dec. 19*th*.—The maker's errors and rates were	2 52.2	7 39.7
	0 1.3 losing.	0 3.3 gaining.

Hence the mean of these ⊙ E. and W. of ☾ lunars is 9m. 20s. or 140′ W. of 1690, and 3m. 27s. or 51¾′ W. of 1759.

And these ⊙ E. ☾ rates differ from those supplied by the maker thus :—

1690 losing 11. 6s. more daily. 1759 gaining 3. 2s. less daily.

I have no doubt this sudden change in the rates of the chronometers was caused by increased heat, the ship being near the equator. A similar change took place near the equator in the Atlantic; since which time 1759 had partially recovered its old rate, but 1690 went pretty steadily at its new rate, and now makes a further stride into the path of error. Had our chronometers been rated with reference to temperature, so much recommended by Mr. Hartnup, in Liverpool, they would have given us the Longitude more correctly.

Now we are drawing near to Madras, and as no more lunars can be obtained, it becomes requisite to decide upon the ship's position: to aid us we will examine the movements of No. 1759 during the passage, this being our best chronometer.

Oct.	10th,	⊙ E. and W. ☾	lunars made 1759*	14′	E. of truth.
„	15th,	✱ E. and W. of ☾	„	34¼†	„
„	22nd,	⊙ E. and W. of ☾	„	18¾	„
Nov.	4th,	„	„	30¾	„
„	21st,	„	„	34¼	„
Dec.	7th,	„	„	42	„
„	15th,	✱ E. and W. of ☾	„	49¼	„
„	19th,	⊙ E. and W. of ☾	„	51¾	„

Here is abundant evidence that No. 1759 chronometer, with the maker's error applied, is about fifty miles East of truth. The same method shows that 1690 is 140 miles East of truth. Therefore we will combine the rate by the * lunars of Dec. 15th with that by the ⊙ lunars of Dec. 19th, and we will allow that on Dec. 19th, 1759, chronometer is 4m. 12. 4s fast, and gaining 1.4s. daily; also that 1690 is 12m. 12.0s. slow, and losing 12.9s. daily. Its last lunar rate is retained without combining it with that found on the 15th because it is known to go very badly and their second difference requires it.

Dec. 31*st.*—The flash of the Madras gun gives us the following errors :—
1759 4m. 32. 9s. fast. 1690 14m. 56. 0s. slow.
By bringing the above lunar errors up to Dec. 31st we have—
1759 4m. 29s. fast. 1690 14m. 46. 7s. slow.
So that we have the correct longitude to a mile by 1759, and to 2¼ miles by 1690 chronometer.

Surely this table is a fair proof of the great value of lunars and a protest against the way in which they are now neglected. Still, young beginners cannot be too often cautioned that a single lunar is of little or no value until the observer knows the usual difference between his lunars taken on opposite sides of the moon ; and these should be taken with the same instrument, using the same screens and telescope, for he must remember that they may be expected to differ. My star lunars differ from three to four minutes, or say fifty miles of longitude ; my sun lunars from one to two minutes, or say twenty minutes of longitude. Knowing this, a single lunar is very valuable to me.

Many people only take lunars after they have been some weeks away from port, but nothing will give such confidence in them as taking them just after leaving port, when the true longitude is well known. This gives the observer that constant error for lunars taken on each side of the moon which is so valuable ; in fact, during the early part of the voyage the chronometers give the errors of the lunars, which kind office the lunars return as the passage draws to a close. This remark is most applicable to sun and moon lunars, where you have to wait a fortnight before distances can be obtained on both sides of the moon.

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* Having the maker's error applied.

† These ✱ E. and W. of ☾ lunars are the only diversion in the proof that this chronometer is altering by a steady progression. Even they cautioned us in the right direction, just as we were about to sight the Rocas ; and the ⊙ and ☾ lunars of five days earlier showed us that they are extreme in their caution.

To illustrate this we will give the sun and moon lunars taken during our short passages in the Indian seas.

	No. 1690. *Slow of G.M.T.*	No. 1759. *Fast of G.M.T.*
	m. s.	m. s.
Feb. 25th, 1859.—The mean of two sets of ⊙ E. ☾ lunars gave the following errors for the chronometers	26 20.1	6 50.0
These errors compared with the ⊙ E. ☾ errors found Dec. 26th give the following rates to the chronometers	0 12.8 losing.	0 1.9 gaining.
These errors meaned with the ⊙ W. ☾ errors found March 12th give the following errors on March 5th..	29 17.4	6 26.2
Mar. 5th.—In Madras the gun flash gave these errors and rates	29 27.1	6 22.4
	0 17.3 losing.	0 1.2 gaining.

Hence the mean of these ⊙ E. and W. ☾ lunars is 10s. or 2½′ E. of 1690, and 4s. or 1′ E. of 1759.

And these ⊙ E. ☾ rates differ from the Madras rates thus :—
1690 losing 4.9s. less daily. 1759 gaining 0.7s. more daily.

Mar. 12th.—The mean of two sets of ⊙ W. ☾ lunars gave the following errors for the chronometers	32 2.0	6 0.3
These errors compared with the ⊙ W. ☾ errors found Dec. 12th give the following rates to the chronometers...........................	0 13.4 losing.	0 1.6 gaining.

The meaning of these errors with those taken Feb. 25th is given above.

Hence these ⊙ W. ☾ rates differ from the Madras rates thus :—
1690 losing 3.9s. less daily. 1759 gaining 0.4s. more daily.

Here we must remark that the ship was in Madras on March 5th, so that the actual errors of the chronometers were known, and the mean of the lunar errors agrees with it to one mile in the case of the best chronometer, and its last lunar rate to four-tenths of a second; but rates found in port are not of great value, because changing the cargo disturbs the chronometers very much.

The use of these lunars taken when the ship's actual position was known, is this: we learn from them that my ⊙ E. ☾ lunars give a position about 8½ miles East of truth, and the ⊙ W. ☾ ones the same amount West of truth. This known makes one set of lunars valuable.

It would be of little use to give the results of my lunars during the passage home,—they are to be found in the log kept for the Board of Trade; suffice it to say that they give a position about fifteen miles East of our best chronometer. So that, relying on them, we steered for the

Lizard Lights, and about 9h. 30m. p.m. of August 12th we found our position by altitudes of the North Star and Arcturus, which put us about twenty-eight miles from the Lizard. The look-out man was then ordered to go on the fore-topsail yard: he reported the lights immediately.

August 17th.—The chronometers were taken by Messrs. Brockbank & Atkins, who at my request watched their rates for nine days, which I give below.

	No. 1690.		No. 1759.	
	s.		s.	
August 18th	12. 5	losing.	0. 5	losing.
„ 19th	12. 5	„	0. 5	gaining.
„ 20th	11. 5	„	1. 0	„
„ 21st	10. 5	„	1. 5	„
„ 22nd	10. 5	„	1. 5	„
„ 23rd	9. 8	„	1. 3	„
„ 24th	9. 8	„	1. 3	„
„ 25th	9. 8	„	1. 8	„
„ 26th	9. 8	„	1. 8	„

Now from St. Helena to England their sea rates had been about:—
1690 13. 5s. losing. 1759 2. 0s. gaining.

Here it seems that 1690 had taken up a steady daily rate of 3. 7s. less than its sea-rate, whilst the good chronometer 1759 was inclined to return to its sea rate; showing that a chronometer is liable to be affected by the change it undergoes in being taken from a ship at sea to a maker's shop in the city of London, and *vice versâ*, which is the most important side of the argument.

I think it has now been proved that the time has not yet come for throwing to one side that great benefit conferred on navigation by the Greenwich Observatory, in bringing the lunar tables to such perfection that the longitude may be ascertained at sea by means of the angular distance between the moon and other heavenly bodies; but that this method has, side by side with chronometers, been making rapid strides in improvement, and that hand in hand they insure the certainty of the longitude even though a ship should continue four years out of sight of land. The period four years is merely mentioned because the *Nautical Almanacs* are published for that time in advance.

TABLE I.

Difference of Latitude and Departure for ¼ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.0	61	60.9	03.0	121	120.9	05.9	181	180.8	08.9	241	240.7	11.8
2	02.0	00.1	62	61.9	03.0	122	121.9	06.0	182	181.8	08.9	242	241.7	11.9
3	03.0	00.1	63	62.9	03.1	123	122.9	06.0	183	182.8	09.0	243	242.7	11.9
4	04.0	00.2	64	63.9	03.1	124	123.9	06.1	184	183.8	09.0	244	243.7	12.0
5	05.0	00.2	65	64.9	03.2	125	124.9	06.1	185	184.8	09.1	245	244.7	12.0
6	06.0	00.3	66	65.9	03.2	126	125.8	06.2	186	185.8	09.1	246	245.7	12.1
7	07.0	00.3	67	66.9	03.3	127	126.8	06.2	187	186.8	09.2	247	246.7	12.1
8	08.0	00.4	68	67.9	03.3	128	127.8	06.3	188	187.8	09.2	248	247.7	12.2
9	09.0	00.4	69	68.9	03.4	129	128.8	06.3	189	188.8	09.3	249	248.7	12.2
10	10.0	00.5	70	69.9	03.4	130	129.8	06.4	190	189.8	09.3	250	249.7	12.3
11	11.0	00.5	71	70.9	03.5	131	130.8	06.4	191	190.8	09.4	251	250.7	12.3
12	12.0	00.6	72	71.9	03.5	132	131.8	06.5	192	191.8	09.4	252	251.7	12.4
13	13.0	00.6	73	72.9	03.6	133	132.8	06.5	193	192.8	09.5	253	252.7	12.4
14	14.0	00.7	74	73.9	03.6	134	133.8	06.6	194	193.8	09.5	254	253.7	12.5
15	15.0	00.7	75	74.9	03.7	135	134.8	06.6	195	194.8	09.6	255	254.7	12.5
16	16.0	00.8	76	75.9	03.7	136	135.8	06.7	196	195.8	09.6	256	255.7	12.6
17	17.0	00.8	77	76.9	03.8	137	136.8	06.7	197	196.8	09.7	257	256.7	12.6
18	18.0	00.9	78	77.9	03.8	138	137.8	06.8	198	197.8	09.7	258	257.7	12.7
19	19.0	00.9	79	78.9	03.9	139	138.8	06.8	199	198.8	09.8	259	258.7	12.7
20	20.0	01.0	80	79.9	03.9	140	139.8	06.9	200	199.8	09.8	260	259.7	12.8
21	21.0	01.0	81	80.9	04.0	141	140.8	06.9	201	200.8	09.9	261	260.7	12.8
22	22.0	01.1	82	81.9	04.0	142	141.8	07.0	202	201.8	09.9	262	261.7	12.9
23	23.0	01.1	83	82.9	04.1	143	142.8	07.0	203	202.8	10.0	263	262.7	12.9
24	24.0	01.2	84	83.9	04.1	144	143.8	07.1	204	203.8	10.0	264	263.7	13.0
25	25.0	01.2	85	84.9	04.2	145	144.8	07.1	205	204.8	10.1	265	264.7	13.0
26	26.0	01.3	86	85.9	04.2	146	145.8	07.2	206	205.8	10.1	266	265.7	13.1
27	27.0	01.3	87	86.9	04.3	147	146.8	07.2	207	206.8	10.2	267	266.7	13.1
28	28.0	01.4	88	87.9	04.3	148	147.8	07.3	208	207.8	10.2	268	267.7	13.2
29	29.0	01.4	89	88.9	04.4	149	148.8	07.3	209	208.8	10.3	269	268.7	13.2
30	30.0	01.5	90	89.9	04.4	150	149.8	07.4	210	209.8	10.3	270	269.7	13.3
31	31.0	01.5	91	90.9	04.5	151	150.8	07.4	211	210.7	10.4	271	270.7	13.3
32	32.0	01.6	92	91.9	04.5	152	151.8	07.5	212	211.7	10.4	272	271.7	13.3
33	33.0	01.6	93	92.9	04.6	153	152.8	07.5	213	212.7	10.5	273	272.7	13.4
34	34.0	01.7	94	93.9	04.6	154	153.8	07.6	214	213.7	10.5	274	273.7	13.4
35	35.0	01.7	95	94.9	04.7	155	154.8	07.6	215	214.7	10.6	275	274.7	13.5
36	36.0	01.8	96	95.9	04.7	156	155.8	07.7	216	215.7	10.6	276	275.7	13.5
37	37.0	01.8	97	96.9	04.8	157	156.8	07.7	217	216.7	10.7	277	276.7	13.6
38	38.0	01.9	98	97.9	04.8	158	157.8	07.8	218	217.7	10.7	278	277.7	13.6
39	39.0	01.9	99	98.9	04.9	159	158.8	07.8	219	218.7	10.8	279	278.7	13.7
40	40.0	02.0	100	99.9	04.9	160	159.8	07.9	220	219.7	10.8	280	279.7	13.7
41	41.0	02.0	101	100.9	05.0	161	160.8	07.9	221	220.7	10.8	281	280.7	13.8
42	41.9	02.1	102	101.9	05.0	162	161.8	08.0	222	221.7	10.9	282	281.7	13.8
43	42.9	02.1	103	102.9	05.1	163	162.8	08.0	223	222.7	10.9	283	282.7	13.9
44	43.9	02.2	104	103.9	05.1	164	163.8	08.1	224	223.7	11.0	284	283.7	13.9
45	44.9	02.2	105	104.9	05.2	165	164.8	08.1	225	224.7	11.0	285	284.7	14.0
46	45.9	02.3	106	105.9	05.2	166	165.8	08.2	226	225.7	11.1	286	285.7	14.0
47	46.9	02.3	107	106.9	05.3	167	166.8	08.2	227	226.7	11.1	287	286.7	14.1
48	47.9	02.4	108	107.9	05.3	168	167.8	08.2	228	227.7	11.2	288	287.7	14.1
49	48.9	02.4	109	108.9	05.4	169	168.8	08.3	229	228.7	11.2	289	288.7	14.2
50	49.9	02.5	110	109.9	05.4	170	169.8	08.3	230	229.7	11.3	290	289.7	14.2
51	50.9	02.5	111	110.9	05.5	171	170.8	08.4	231	230.7	11.3	291	290.7	14.3
52	51.9	02.6	112	111.9	05.5	172	171.8	08.4	232	231.7	11.4	292	291.7	14.3
53	52.9	02.6	113	112.9	05.5	173	172.8	08.5	233	232.7	11.4	293	292.7	14.4
54	53.9	02.7	114	113.9	05.6	174	173.8	08.5	234	233.7	11.5	294	293.6	14.4
55	54.9	02.7	115	114.9	05.6	175	174.8	08.6	235	234.7	11.5	295	294.6	14.5
56	55.9	02.8	116	115.9	05.7	176	175.8	08.6	236	235.7	11.6	296	295.6	14.5
57	56.9	02.8	117	116.9	05.7	177	176.8	08.7	237	236.7	11.6	297	296.6	14.6
58	57.9	02.9	118	117.9	05.8	178	177.8	08.7	238	237.7	11.7	298	297.6	14.6
59	58.9	02.9	119	118.9	05.8	179	178.8	08.8	239	238.7	11.7	299	298.6	14.7
60	59.9	02.9	120	119.9	05.9	180	179.8	08.8	240	239.7	11.8	300	299.6	14.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 7¾ Points.

TABLE I.

Difference of Latitude and Departure for ½ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.7	06.0	121	120.4	11.9	181	180.1	17.7	241	239.8	23.6
2	02.0	00.2	62	61.7	06.1	122	121.4	12.0	182	181.1	17.8	242	240.8	23.7
3	03.0	00.3	63	62.7	06.2	123	122.4	12.1	183	182.1	17.9	243	241.8	23.8
4	04.0	00.4	64	63.7	06.3	124	123.4	12.2	184	183.1	18.0	244	242.8	23.9
5	05.0	00.5	65	64.7	06.4	125	124.4	12.3	185	184.1	18.1	245	243.8	24.0
6	06.0	00.6	66	65.7	06.5	126	125.4	12.3	186	185.1	18.2	246	244.8	24.1
7	07.0	00.7	67	66.7	06.6	127	126.4	12.4	187	186.1	18.3	247	245.8	24.2
8	08.0	00.8	68	67.7	06.7	128	127.4	12.5	188	187.1	18.4	248	246.8	24.3
9	09.0	00.9	69	68.7	06.8	129	128.4	12.6	189	188.1	18.5	249	247.8	24.4
10	10.0	01.0	70	69.7	06.9	130	129.4	12.7	190	189.1	18.6	250	248.8	24.5
11	10.9	01.1	71	70.7	07.0	131	130.4	12.8	191	190.1	18.7	251	249.8	24.6
12	11.9	01.2	72	71.7	07.1	132	131.4	12.9	192	191.1	18.8	252	250.8	24.7
13	12.9	01.3	73	72.6	07.2	133	132.4	13.0	193	192.1	18.9	253	251.8	24.8
14	13.9	01.4	74	73.6	07.3	134	133.4	13.1	194	193.1	19.0	254	252.8	24.9
15	14.9	01.5	75	74.6	07.4	135	134.3	13.2	195	194.1	19.1	255	253.8	25.0
16	15.9	01.6	76	75.6	07.4	136	135.3	13.3	196	195.1	19.2	256	254.8	25.1
17	16.9	01.7	77	76.6	07.5	137	136.3	13.4	197	196.1	19.3	257	255.8	25.2
18	17.9	01.8	78	77.6	07.6	138	137.3	13.5	198	197.0	19.4	258	256.8	25.3
19	18.9	01.9	79	78.6	07.7	139	138.3	13.6	199	198.0	19.5	259	257.8	25.4
20	19.9	02.0	80	79.6	07.8	140	139.3	13.7	200	199.0	19.6	260	258.7	25.5
21	20.9	02.1	81	80.6	07.9	141	140.3	13.8	201	200.0	19.7	261	259.7	25.6
22	21.9	02.2	82	81.6	08.0	142	141.3	13.9	202	201.0	19.8	262	260.7	25.7
23	22.9	02.3	83	82.6	08.1	143	142.3	14.0	203	202.0	19.9	263	261.7	25.8
24	23.9	02.4	84	83.6	08.2	144	143.3	14.1	204	203.0	20.0	264	262.7	25.9
25	24.9	02.4	85	84.6	08.3	145	144.3	14.2	205	204.0	20.1	265	263.7	26.0
26	25.9	02.5	86	85.6	08.4	146	145.3	14.3	206	205.0	20.2	266	264.7	26.1
27	26.9	02.6	87	86.6	08.5	147	146.3	14.4	207	206.0	20.3	267	265.7	26.2
28	27.9	02.7	88	87.6	08.6	148	147.3	14.5	208	207.0	20.4	268	266.7	26.3
29	28.9	02.8	89	88.6	08.7	149	148.3	14.6	209	208.0	20.5	269	267.7	26.4
30	29.9	02.9	90	89.6	08.8	150	149.3	14.7	210	209.0	20.6	270	268.7	26.5
31	30.9	03.0	91	90.6	08.9	151	150.3	14.8	211	210.0	20.7	271	269.7	26.6
32	31.8	03.1	92	91.6	09.0	152	151.3	14.9	212	211.0	20.8	272	270.7	26.7
33	32.8	03.2	93	92.6	09.1	153	152.3	15.0	213	212.0	20.9	273	271.7	26.8
34	33.8	03.3	94	93.5	09.2	154	153.3	15.1	214	213.0	21.0	274	272.7	26.9
35	34.8	03.4	95	94.5	09.3	155	154.3	15.2	215	214.0	21.1	275	273.7	27.0
36	35.8	03.5	96	95.5	09.4	156	155.2	15.3	216	215.0	21.2	276	274.7	27.1
37	36.8	03.6	97	96.5	09.5	157	156.2	15.4	217	216.0	21.3	277	275.7	27.2
38	37.8	03.7	98	97.5	09.6	158	157.2	15.5	218	216.9	21.4	278	276.7	27.3
39	38.8	03.8	99	98.5	09.7	159	158.2	15.6	219	217.9	21.5	279	277.7	27.3
40	39.8	03.9	100	99.5	09.8	160	159.2	15.7	220	218.9	21.6	280	278.7	27.4
41	40.8	04.0	101	100.5	09.9	161	160.2	15.8	221	219.9	21.7	281	279.6	27.5
42	41.8	04.1	102	101.5	10.0	162	161.2	15.9	222	220.9	21.8	282	280.6	27.6
43	42.8	04.2	103	102.5	10.1	163	162.2	16.0	223	221.9	21.9	283	281.6	27.7
44	43.8	04.3	104	103.5	10.2	164	163.2	16.1	224	222.9	22.0	284	282.6	27.8
45	44.8	04.4	105	104.5	10.3	165	164.2	16.2	225	223.9	22.1	285	283.6	27.9
46	45.8	04.5	106	105.5	10.4	166	165.2	16.3	226	224.9	22.2	286	284.6	28.0
47	46.8	04.6	107	106.5	10.5	167	166.2	16.4	227	225.9	22.2	287	285.6	28.1
48	47.8	04.7	108	107.5	10.6	168	167.2	16.5	228	226.9	22.3	288	286.6	28.2
49	48.8	04.8	109	108.5	10.7	169	168.2	16.6	229	227.9	22.4	289	287.6	28.3
50	49.8	04.9	110	109.5	10.8	170	169.2	16.7	230	228.9	22.5	290	288.6	28.4
51	50.8	05.0	111	110.5	10.9	171	170.2	16.8	231	229.9	22.6	291	289.6	28.5
52	51.7	05.1	112	111.5	11.0	172	171.2	16.9	232	230.9	22.7	292	290.6	28.6
53	52.7	05.2	113	112.5	11.1	173	172.2	17.0	233	231.9	22.8	293	291.6	28.7
54	53.7	05.3	114	113.5	11.2	174	173.2	17.1	234	232.9	22.9	294	292.6	28.8
55	54.7	05.4	115	114.4	11.3	175	174.2	17.2	235	233.9	23.0	295	293.6	28.9
56	55.7	05.5	116	115.4	11.4	176	175.2	17.3	236	234.9	23.1	296	294.6	29.0
57	56.7	05.6	117	116.4	11.5	177	176.1	17.4	237	235.9	23.2	297	295.6	29.1
58	57.7	05.7	118	117.4	11.6	178	177.1	17.4	238	236.9	23.3	298	296.6	29.2
59	58.7	05.8	119	118.4	11.7	179	178.1	17.5	239	237.8	23.4	299	297.6	29.3
60	59.7	05.9	120	119.4	11.8	180	179.1	17.6	240	238.8	23.5	300	298.6	29.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 7½ Points.

TABLE I.

Difference of Latitude and Departure for ¾ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.3	09.0	121	119.7	17.8	181	179.0	26.6	241	238.4	35.4
2	02.0	00.3	62	61.3	09.1	122	120.7	17.9	182	180.0	26.7	242	239.4	35.5
3	03.0	00.4	63	62.3	09.2	123	121.7	18.1	183	181.0	26.9	243	240.4	35.7
4	04.0	00.6	64	63.3	09.4	124	122.7	18.2	184	182.0	27.0	244	241.4	35.8
5	04.9	00.7	65	64.3	09.5	125	123.7	18.3	185	183.0	27.2	245	242.4	36.0
6	05.9	00.9	66	65.3	09.7	126	124.6	18.5	186	184.0	27.3	246	243.3	36.1
7	06.9	01.0	67	66.3	09.8	127	125.6	18.6	187	185.0	27.4	247	244.3	36.2
8	07.9	01.2	68	67.3	10.0	128	126.6	18.8	188	186.0	27.6	248	245.3	36.4
9	08.9	01.3	69	68.3	10.1	129	127.6	18.9	189	187.0	27.7	249	246.3	36.5
10	09.9	01.5	70	69.2	10.3	130	128.6	19.1	190	187.9	27.9	250	247.3	36.7
11	10.9	01.6	71	70.2	10.4	131	129.6	19.2	191	188.9	28.0	251	248.3	36.8
12	11.9	01.8	72	71.2	10.6	132	130.6	19.4	192	189.9	28.2	252	249.3	37.0
13	12.9	01.9	73	72.2	10.7	133	131.6	19.5	193	190.9	28.3	253	250.3	37.1
14	13.9	02.1	74	73.2	10.9	134	132.6	19.7	194	191.9	28.5	254	251.3	37.3
15	14.8	02.2	75	74.2	11.0	135	133.5	19.8	195	192.9	28.6	255	252.2	37.4
16	15.8	02.3	76	75.2	11.2	136	134.5	20.0	196	193.9	28.8	256	253.2	37.6
17	16.8	02.5	77	76.2	11.3	137	135.5	20.1	197	194.9	28.9	257	254.2	37.7
18	17.8	02.6	78	77.2	11.4	138	136.5	20.3	198	195.9	29.1	258	255.2	37.9
19	18.8	02.8	79	78.1	11.6	139	137.5	20.4	199	196.8	29.2	259	256.2	38.0
20	19.8	02.9	80	79.1	11.7	140	138.5	20.5	200	197.8	29.4	260	257.2	38.2
21	20.8	03.1	81	80.1	11.9	141	139.5	20.7	201	198.8	29.5	261	258.2	38.3
22	21.8	03.2	82	81.1	12.0	142	140.5	20.8	202	199.8	29.6	262	259.2	38.4
23	22.8	03.4	83	82.1	12.2	143	141.5	21.0	203	200.8	29.8	263	260.2	38.6
24	23.7	03.5	84	83.1	12.3	144	142.4	21.1	204	201.8	29.9	264	261.1	38.7
25	24.7	03.7	85	84.1	12.5	145	143.4	21.3	205	202.8	30.1	265	262.1	38.9
26	25.7	03.8	86	85.1	12.6	146	144.4	21.4	206	203.8	30.2	266	263.1	39.0
27	26.7	04.0	87	86.1	12.8	147	145.4	21.6	207	204.8	30.4	267	264.1	39.2
28	27.7	04.1	88	87.1	12.9	148	146.4	21.7	208	205.8	30.5	268	265.1	39.3
29	28.7	04.3	89	88.0	13.1	149	147.4	21.9	209	206.7	30.7	269	266.1	39.5
30	29.7	04.4	90	89.0	13.2	150	148.4	22.0	210	207.7	30.8	270	267.1	39.6
31	30.7	04.6	91	90.0	13.4	151	149.4	22.2	211	208.7	31.0	271	268.1	39.8
32	31.7	04.7	92	91.0	13.5	152	150.4	22.3	212	209.7	31.1	272	269.1	39.9
33	32.6	04.8	93	92.0	13.7	153	151.3	22.5	213	210.7	31.3	273	270.0	40.1
34	33.6	05.0	94	93.0	13.8	154	152.3	22.6	214	211.7	31.4	274	271.0	40.2
35	34.6	05.1	95	94.0	13.9	155	153.3	22.7	215	212.7	31.6	275	272.0	40.4
36	35.6	05.3	96	95.0	14.1	156	154.3	22.9	216	213.7	31.7	276	273.0	40.5
37	36.6	05.4	97	96.0	14.2	157	155.3	23.0	217	214.7	31.8	277	274.0	40.6
38	37.6	05.6	98	96.9	14.4	158	156.3	23.2	218	215.6	32.0	278	275.0	40.8
39	38.6	05.7	99	97.9	14.5	159	157.3	23.3	219	216.6	32.1	279	276.0	40.9
40	39.6	05.9	100	98.9	14.7	160	158.3	23.5	220	217.6	32.3	280	277.0	41.1
41	40.6	06.0	101	99.9	14.8	161	159.3	23.6	221	218.6	32.4	281	278.0	41.2
42	41.6	06.2	102	100.9	15.0	162	160.3	23.8	222	219.6	32.6	282	279.0	41.4
43	42.5	06.3	103	101.9	15.1	163	161.2	23.9	223	220.6	32.7	283	279.9	41.5
44	43.5	06.5	104	102.9	15.3	164	162.2	24.1	224	221.6	32.9	284	280.9	41.7
45	44.5	06.6	105	103.9	15.4	165	163.2	24.2	225	222.6	33.0	285	281.9	41.8
46	45.5	06.8	106	104.9	15.6	166	164.2	24.4	226	223.6	33.2	286	282.9	42.0
47	46.5	06.9	107	105.8	15.7	167	165.2	24.5	227	224.5	33.3	287	283.9	42.1
48	47.5	07.0	108	106.8	15.9	168	166.2	24.7	228	225.5	33.5	288	284.9	42.3
49	48.5	07.2	109	107.8	16.0	169	167.2	24.8	229	226.5	33.6	289	285.9	42.4
50	49.5	07.3	110	108.8	16.1	170	168.2	24.9	230	227.5	33.8	290	286.9	42.6
51	50.5	07.5	111	109.8	16.3	171	169.2	25.1	231	228.5	33.9	291	287.9	42.7
52	51.4	07.6	112	110.8	16.4	172	170.1	25.2	232	229.5	34.0	292	288.8	42.9
53	52.4	07.8	113	111.8	16.6	173	171.1	25.4	233	230.5	34.2	293	289.8	43.0
54	53.4	07.9	114	112.8	16.7	174	172.1	25.5	234	231.5	34.3	294	290.8	43.1
55	54.4	08.1	115	113.8	16.9	175	173.1	25.7	235	232.5	34.5	295	291.8	43.3
56	55.4	08.2	116	114.7	17.0	176	174.1	25.8	236	233.4	34.6	296	292.8	43.4
57	56.4	08.4	117	115.7	17.2	177	175.1	26.0	237	234.4	34.8	297	293.8	43.6
58	57.4	08.5	118	116.7	17.3	178	176.1	26.1	238	235.4	34.9	298	294.8	43.7
59	58.4	08.7	119	117.7	17.5	179	177.1	26.3	239	236.4	35.1	299	295.8	43.9
60	59.4	08.8	120	118.7	17.6	180	178.1	26.4	240	237.4	35.2	300	296.8	44.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 7¼ Points.

TABLE I.

Difference of Latitude and Departure for 1 Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.8	11.9	121	118.7	23.6	181	177.5	35.3	241	236.4	47.0
2	02.0	00.4	62	60.8	12.1	122	119.7	23.8	182	178.5	35.5	242	237.4	47 2
3	02.9	00.6	63	61.8	12.3	123	120.6	24.0	183	179.5	35.7	243	238.3	47.4
4	03.9	00.8	64	62.8	12.5	124	121.6	24.2	184	180.5	35.9	244	239.3	47.6
5	04.9	01.0	65	63.8	12.7	125	122.6	24.4	185	181.5	36.1	245	240.3	47.8
6	05.9	01.2	66	64.7	12.9	126	123.6	24.6	186	182.4	36.3	246	241.3	48.0
7	06.9	01.4	67	65.7	13.1	127	124.6	24.8	187	183.4	36.5	247	242.3	48.2
8	07.8	01.6	68	66.7	13.3	128	125.5	25.0	188	184.4	36.7	248	243.2	48.4
9	08.8	01.8	69	67.7	13.5	129	126.5	25.2	189	185.4	36.9	249	244.2	48.6
10	09.8	02.0	70	68.7	13.7	130	127.5	25.4	190	186.4	37.1	250	245.2	48.8
11	10.8	02.2	71	69.6	13.9	131	128.5	25.6	191	187.3	37.3	251	246.2	49.0
12	11.8	02.3	72	70.6	14.0	132	129.5	25.8	192	188.3	37.5	252	247.2	49.2
13	12.8	02.5	73	71.6	14.2	133	130.5	26.0	193	189.3	37.7	253	248.1	49.4
14	13.7	02.7	74	72.6	14.4	134	131.4	26.1	194	190.3	37.8	254	249.1	49.6
15	14.7	02.9	75	73.6	14.6	135	132.4	26.3	195	191.3	38.0	255	250.1	49.7
16	15.7	03.1	76	74.5	14.8	136	133.4	26.5	196	192.2	38.2	256	251.1	49.9
17	16.7	03.3	77	75.5	15.0	137	134.4	26.7	197	193.2	38.4	257	252.1	50.1
18	17.7	03.5	78	76.5	15.2	138	135.4	26.9	198	194.2	38.6	258	253.0	50.3
19	18.6	03.7	79	77.5	15.4	139	136.3	27.1	199	195.2	38.8	259	254.0	50.5
20	19.6	03.9	80	78.5	15.6	140	137.3	27.3	200	196.2	39.0	260	255.0	50.7
21	20.6	04.1	81	79.4	15.8	141	138.3	27.5	201	197.1	39.2	261	256.0	50.9
22	21.6	04.3	82	80.4	16.0	142	139.3	27.7	202	198.1	39.4	262	257.0	51.1
23	22.6	04.5	83	81.4	16.2	143	140.3	27.9	203	199.1	39.6	263	258.0	51.3
24	23.5	04.7	84	82.4	16.4	144	141.2	28.1	204	200.1	39.8	264	258.9	51.5
25	24.5	04.9	85	83.4	16.6	145	142.2	28.3	205	201.1	40.0	265	259.9	51 7
26	25.5	05.1	86	84.4	16.8	146	143.2	28.5	206	202.0	40.2	266	260.9	51.9
27	26.5	05.3	87	85.3	17.0	147	144.2	28.7	207	203.0	40.4	267	261.9	52.1
28	27.5	05.5	88	86.3	17.2	148	145.2	28.9	208	204.0	40.6	268	262.9	52.3
29	28.4	05.7	89	87.3	17.4	149	146.1	29.1	209	205.0	40.8	269	263 8	52.5
30	29.4	05.9	90	88.3	17.6	150	147.1	29.3	210	206.0	41.0	270	264.8	52.7
31	30.4	06.0	91	89.3	17.8	151	148.1	29.5	211	207.0	41.2	271	265.8	52.9
32	31.4	06.2	92	90.2	18.0	152	149.1	29.7	212	207.9	41.4	272	266.8	53.1
33	32.4	06.4	93	91.2	18.1	153	150.1	29.9	213	208.9	41.6	273	267.8	53.3
34	33.4	06.6	94	92.2	18.3	154	151.0	30.0	214	209.9	41.8	274	268.7	53.5
35	34.5	06 8	95	93.2	18.5	155	152.0	30.2	215	210.9	41.9	275	269.7	53.6
36	35.3	07.0	96	94.2	18.7	156	153.0	30.4	216	211.9	42.1	276	270.7	53.8
37	36.3	07.2	97	95.1	18.9	157	154.0	30.6	217	212.8	42.3	277	271.7	54.0
38	37.3	07.4	98	96.1	19.1	158	155.0	30.8	218	213.8	42.5	278	272.7	54.2
39	38.3	07.6	99	97.1	19.3	159	156.0	31.0	219	214.8	42.7	279	273.6	54.4
40	39.2	07.8	100	98.1	19.5	160	156.9	31.2	220	215.8	42.9	280	274.6	54.6
41	40.2	08.0	101	99.1	19.7	161	157.9	31.4	221	216.8	43.1	281	275 6	54.8
42	41.2	08.2	102	100.0	19.9	162	158.9	31.6	222	217.7	43.3	282	276.6	55.0
43	42.2	08.4	103	101.0	20.1	163	159.9	31.8	223	218.7	43.5	283	277.6	55.2
44	43.2	08.6	104	102.0	20.3	164	160.9	32.0	224	219.7	43.7	284	278.5	55.4
45	44.1	08.8	105	103.0	20.5	165	161.8	32.2	225	220.7	43.9	285	279.5	55.6
46	45.1	09.0	106	104.0	20.7	166	162.8	32.4	226	221.7	44.1	286	280.5	55.8
47	46.1	09.2	107	104.9	20.9	167	163.8	32.6	227	222.6	44.3	287	281.5	56.0
48	47.1	09.4	108	105.9	21.1	168	164.8	32.8	228	223.6	44.5	288	282.5	56.2
49	48.1	09.6	109	106.9	21.3	169	165.8	33.0	229	224.6	44.7	289	283.5	56.4
50	49.0	09.8	110	107.9	21.5	170	166.7	33.2	230	225.6	44.9	290	284.4	56.6
51	50.0	10.0	111	108.9	21.7	171	167.7	33.4	231	226.6	45.1	291	285.4	56.8
52	51.0	10.1	112	109.9	21.9	172	168.7	33.6	232	227.5	45.3	292	286.4	57.0
53	52.0	10.3	113	110.8	22.0	173	169.7	33.8	233	228.5	45.5	293	287.4	57.2
54	53.0	10.5	114	111.8	22.2	174	170.7	34.0	234	229.5	45.7	294	288.4	57.4
55	53.9	10.7	115	112.8	22.4	175	171.6	34 1	235	230.5	45.9	295	289.3	57.6
56	54.9	10.9	116	113.8	22.6	176	172.6	34.3	236	231.5	46.0	296	290.3	57.7
57	55.9	11.1	117	114.8	22.8	177	173.6	34.5	237	232.5	46.2	297	291.3	57.9
58	56.9	11.3	118	115.7	23.0	178	174.6	34.7	238	233.4	46.4	298	292.3	58.1
59	57.9	11.5	119	116.7	23.2	179	175.6	34.9	239	234.4	46.6	299	293.3	58.3
60	58 8	11.7	120	117.7	23.4	180	176.5	35.1	240	235.4	46.8	300	294.2	58.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 7 Points.

TABLE I.

Difference of Latitude and Departure for 1¼ Point.

Dist	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.4	181	175.6	44.0	241	233.8	58.6
2	01.9	00.5	62	60.1	15.1	122	118.4	29.6	182	176.5	44.2	242	234.8	58.8
3	02.9	00.7	63	61.1	15.3	123	119.3	29.9	183	177.5	44.5	243	235.7	59.0
4	03.9	01.0	64	62.1	15.6	124	120.3	30.1	184	178.5	44.7	244	236.7	59.3
5	04.9	01.2	65	63.1	15.8	125	121.3	30.4	185	179.5	45.0	245	237.7	59.5
6	05.8	01.5	66	64.0	16.0	126	122.2	30.6	186	180.4	45.2	246	238.6	59.8
7	06.8	01.7	67	65.0	16.3	127	123.2	30.9	187	181.4	45.4	247	239.6	60.0
8	07.8	01.9	68	66.0	16.5	128	124.2	31.1	188	182.4	45.7	248	240.6	60.3
9	08.7	02.2	69	66.9	16.8	129	125.1	31.3	189	183.3	45.9	249	241.6	60.5
10	09.7	02.4	70	67.9	17.0	130	126.1	31.6	190	184.3	46.2	250	242.5	60.8
11	10.7	02.7	71	68.9	17.3	131	127.1	31.8	191	185.3	46.4	251	243.5	61.0
12	11.6	02.9	72	69.9	17.5	132	128.1	32.1	192	186.2	46.7	252	244.5	61.2
13	12.6	03.2	73	70.8	17.7	133	129.0	32.3	193	187.2	46.9	253	245.4	61.5
14	13.6	03.4	74	71.8	18.0	134	130.0	32.6	194	188.2	47.1	254	246.4	61.7
15	14.6	03.6	75	72.8	18.2	135	131.0	32.8	195	189.2	47.4	255	247.4	62.0
16	15.5	03.9	76	73.7	18.5	136	131.9	33.1	196	190.1	47.6	256	248.3	62.2
17	16.5	04.1	77	74.7	18.7	137	132.9	33.3	197	191.1	47.9	257	249.3	62.5
18	17.5	04.4	78	75.7	19.0	138	133.9	33.5	198	192.1	48.1	258	250.3	62.7
19	18.4	04.6	79	76.6	19.2	139	134.8	33.8	199	193.0	48.4	259	251.3	62.9
20	19.4	04.9	80	77.6	19.4	140	135.8	34.0	200	194.0	48.6	260	252.2	63.2
21	20.4	05.1	81	78.6	19.7	141	136.8	34.3	201	195.0	48.8	261	253.2	63.4
22	21.3	05.4	82	79.6	19.9	142	137.8	34.5	202	196.0	49.1	262	254.2	63.7
23	22.3	05.6	83	80.5	20.2	143	138.7	34.8	203	196.9	49.3	263	255.1	63.9
24	23.3	05.8	84	81.5	20.4	144	139.7	35.0	204	197.9	49.6	264	256.1	64.2
25	24.3	06.1	85	82.5	20.7	145	140.7	35.2	205	198.9	49.8	265	257.1	64.4
26	25.2	06.3	86	83.4	20.9	146	141.6	35.5	206	199.8	50.1	266	258.0	64.6
27	26.2	06.6	87	84.4	21.1	147	142.6	35.7	207	200.8	50.3	267	259.0	64.9
28	27.2	06.8	88	85.4	21.4	148	143.6	36.0	208	201.8	50.5	268	260.0	65.1
29	28.1	07.1	89	86.3	21.6	149	144.5	36.2	209	202.7	50.8	269	261.0	65.4
30	29.1	07.3	90	87.3	21.9	150	145.5	36.5	210	203.7	51.0	270	261.9	65.6
31	30.1	07.5	91	88.3	22.1	151	146.5	36.7	211	204.7	51.3	271	262.9	65.9
32	31.0	07.8	92	89.3	22.4	152	147.4	36.9	212	205.7	51.5	272	263.9	66.1
33	32.0	08.0	93	90.2	22.6	153	148.4	37.2	213	206.6	51.8	273	264.8	66.3
34	33.0	08.3	94	91.2	22.8	154	149.4	37.4	214	207.6	52.0	274	265.8	66.6
35	34.6	08.5	95	92.2	23.1	155	150.4	37.7	215	208.6	52.2	275	266.8	66.8
36	34.9	08.8	96	93.1	23.3	156	151.3	37.9	216	209.5	52.5	276	267.7	67.1
37	35.9	09.0	97	94.1	23.6	157	152.3	38.2	217	210.5	52.7	277	268.7	67.3
38	36.9	09.2	98	95.1	23.8	158	153.3	38.4	218	211.5	53.0	278	269.7	67.6
39	37.8	09.5	99	96.0	24.1	159	154.2	38.6	219	212.5	53.2	279	270.7	67.8
40	38.8	09.7	100	97.0	24.3	160	155.2	38.9	220	213.4	53.5	280	271.6	68.0
41	39.8	10.0	101	98.0	24.5	161	156.2	39.1	221	214.4	53.7	281	272.6	68.3
42	40.7	10.2	102	99.0	24.8	162	157.2	39.4	222	215.4	53.9	282	273.6	68.5
43	41.7	10.5	103	99.9	25.0	163	158.1	39.6	223	216.3	54.2	283	274.5	68.8
44	42.7	10.7	104	100.9	25.3	164	159.1	39.9	224	217.3	54.4	284	275.5	69.0
45	43.7	10.9	105	101.9	25.5	165	160.1	40.1	225	218.3	54.7	285	276.5	69.3
46	44.6	11.2	106	102.8	25.8	166	161.0	40.3	226	219.2	54.9	286	277.4	69.5
47	45.6	11.4	107	103.8	26.0	167	162.0	40.6	227	220.2	55.2	287	278.4	69.7
48	46.6	11.7	108	104.8	26.2	168	163.0	40.8	228	221.2	55.4	288	279.4	70.0
49	47.5	11.9	109	105.7	26.5	169	163.9	41.1	229	222.2	55.6	289	280.4	70.2
50	48.5	12.2	110	106.7	26.7	170	164.9	41.3	230	223.1	55.9	290	281.3	70.5
51	49.5	12.4	111	107.7	27.0	171	165.9	41.6	231	224.1	56.1	291	282.3	70.7
52	50.4	12.6	112	108.7	27.2	172	166.9	41.8	232	225.1	56.4	292	283.3	71.0
53	51.4	12.9	113	109.6	27.5	173	167.8	42.0	233	226.0	56.6	293	284.2	71.2
54	52.4	13.1	114	110.6	27.7	174	168.8	42.3	234	227.0	56.9	294	285.2	71.4
55	53.4	13.4	115	111.6	27.9	175	169.8	42.5	235	228.0	57.1	295	286.2	71.7
56	54.3	13.6	116	112.5	28.2	176	170.7	42.8	236	228.9	57.3	296	287.1	71.9
57	55.3	13.9	117	113.5	28.4	177	171.7	43.0	237	229.9	57.6	297	288.1	72.2
58	56.3	14.1	118	114.5	28.7	178	172.7	43.3	238	230.9	57.8	298	289.1	72.4
59	57.2	14.3	119	115.4	28.9	179	173.6	43.5	239	231.8	58.1	299	290.1	72.7
60	58.2	14.6	120	116.4	29.2	180	174.6	43.7	240	232.8	58.3	300	291.0	72.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 6¾ Points.

TABLE I.

Difference of Latitude and Departure for 1½ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.4	17.7	121	115.8	35.1	181	173.2	52.5	241	230.6	70.0
2	01.9	00.6	62	59.3	18.0	122	116.8	35.4	182	174.2	52.8	242	231.6	70.3
3	02.9	00.9	63	60.3	18.3	123	117.7	35.7	183	175.1	53.1	243	232.5	70.5
4	03.8	01.2	64	61.2	18.6	124	118.7	36.0	184	176.1	53.4	244	233.5	70.8
5	04.8	01.5	65	62.2	18.9	125	119.6	36.3	185	177.0	53.7	245	234.5	71.1
6	05.7	01.7	66	63.2	19.2	126	120.6	36.6	186	178.0	54.0	246	235.4	71.4
7	06.7	02.0	67	64.1	19.5	127	121.5	36.9	187	179.0	54.3	247	236.4	71.7
8	07.7	02.3	68	65.1	19.7	128	122.5	37.2	188	179.9	54.6	248	237.3	72.0
9	08.6	02.6	69	66.0	20.0	129	123.5	37.5	189	180.9	54.9	249	238.3	72.3
10	09.6	02.9	70	67.0	20.3	130	124.4	37.7	190	181.8	55.2	250	239.2	72.6
11	10.5	03.2	71	67.9	20.6	131	125.4	38.0	191	182.8	55.4	251	240.2	72.9
12	11.5	03.5	72	68.9	20.9	132	126.3	38.3	192	183.7	55.7	252	241.2	73.2
13	12.4	03.8	73	69.9	21.2	133	127.3	38.6	193	184.7	56.0	253	242.1	73.4
14	13.4	04.1	74	70.8	21.5	134	128.2	38.9	194	185.7	56.3	254	243.1	73.7
15	14.4	04.4	75	71.8	21.8	135	129.2	39.2	195	186.6	56.6	255	244.0	74.0
16	15.3	04.6	76	72.7	22.1	136	130.1	39.5	196	187.6	56.9	256	245.0	74.3
17	16.3	04.9	77	73.7	22.4	137	131.1	39.8	197	188.5	57.2	257	245.9	74.6
18	17.2	05.2	78	74.6	22.6	138	132.1	40.1	198	189.5	57.5	258	246.9	74.9
19	18.2	05.5	79	75.6	22.9	139	133.0	40.4	199	190.4	57.8	259	247.9	75.2
20	19.1	05.8	80	76.6	23.2	140	134.0	40.6	200	191.4	58.1	260	248.8	75.5
21	20.1	06.1	81	77.5	23.5	141	134.9	40.9	201	192.3	58.4	261	249.8	75.8
22	21.1	06.4	82	78.5	23.8	142	135.9	41.2	202	193.3	58.6	262	250.7	76.1
23	22.0	06.7	83	79.4	24.1	143	136.8	41.5	203	194.3	58.9	263	251.7	76.3
24	23.0	07.0	84	80.4	24.4	144	137.8	41.8	204	195.2	59.2	264	252.6	76.6
25	23.9	07.3	85	81.3	24.7	145	138.8	42.1	205	196.2	59.5	265	253.6	76.9
26	24.9	07.6	86	82.3	25.0	146	139.7	42.4	206	197.1	59.8	266	254.6	77.2
27	25.8	07.8	87	83.3	25.3	147	140.7	42.7	207	198.1	60.1	267	255.5	77.5
28	26.8	08 1	88	84.2	25.5	148	141.6	43.0	208	199 0	60.4	268	256.5	77.8
29	27.8	08.4	89	85.2	25.8	149	142.6	43.3	209	200.0	60.7	269	257.4	78.1
30	28.7	08 7	90	86.1	26.1	150	143.5	43.5	210	201.0	61.0	270	258.4	78.4
31	29.7	09.0	91	87.1	26.4	151	144.5	43.8	211	201.9	61.3	271	259.3	78.7
32	30 6	09.3	92	88.0	26.7	152	145.5	44.1	212	202.9	61.5	272	260.3	79.0
33	31.6	09.6	93	89.0	27.0	153	146.4	44 4	213	203.8	61.8	273	261.2	79.3
34	32.5	09.9	94	90.0	27.3	154	147.4	44.7	214	204.8	62.1	274	262.2	79.5
35	33.5	10.2	95	90.9	27.6	155	148.3	45.0	215	205.7	62.4	275	263.2	79.8
36	34.5	10.5	96	91.9	27.9	156	149.3	45.3	216	206.7	62.7	276	264.1	80 1
37	35.4	10.7	97	92.8	28.2	157	150.2	45.6	217	207.7	63.0	277	265.1	80.4
38	36.4	11.0	98	93.8	28.5	158	151.2	45.9	218	208.6	63.3	278	266.0	80.7
39	37.3	11.3	99	94.7	28.7	159	152.2	46.2	219	269.6	63.6	279	267.0	81.0
40	38.3	11.6	100	95.7	29.0	160	153.1	46.4	220	210.5	63.9	280	267.9	81.3
41	39.2	11.9	101	96.7	29.3	161	154.1	46.7	221	211.5	64.2	281	268.9	81.6
42	40.2	12.2	102	97.6	29.6	162	155.0	47.0	222	212.4	64.4	282	269.9	81.9
43	41.2	12.5	103	98.6	29.9	163	156.0	47.3	223	213.4	64.7	283	270.8	82.2
44	42.1	12.8	104	99.5	30.2	164	156.9	47.6	224	214.4	65.0	284	271.8	82.4
45	43.1	13.1	105	100.5	30.5	165	157.9	47.9	225	215.3	65.3	285	272.7	82.7
46	44.0	13.4	106	101.4	30.8	166	158.9	48.2	226	216.3	65.6	286	273.7	83.0
47	45.0	13.6	107	102.4	31.1	167	159.8	48.5	227	217.2	65.9	287	274.6	83.3
48	45.9	13.9	108	103.4	31.4	168	160.8	48.8	228	218.2	66.2	288	275.6	83.6
49	46.9	14.2	109	104.3	31.6	169	161.7	49.1	229	219.1	66.5	289	276.6	83.9
50	47.9	14.5	110	105.3	31.9	170	162.7	49.4	230	220.1	66.8	290	277.5	84.2
51	48.8	14.8	111	106.2	32.2	171	163.6	49.6	231	221.1	67.1	291	278.5	84.5
52	49.8	15.1	112	107.2	32.5	172	164.6	49.9	232	222.0	67.3	292	279.4	84.8
53	50.7	15.4	113	108.1	32.8	173	165.6	50.2	233	223.0	67.6	293	280.4	85.0
54	51.7	15.7	114	109.1	33.1	174	166.5	50.5	234	223.9	67.9	294	281.3	85.3
55	52.6	16.0	115	110.1	33.4	175	167.5	50.8	235	224.9	68.2	295	282.3	85.6
56	53.6	16.3	116	111.0	33.7	176	168.4	51.1	236	225.8	68.5	296	283.3	85.9
57	54.6	16.6	117	112.0	34.0	177	169.4	51.4	237	226.8	68.8	297	284.2	86.2
58	55.5	16.8	118	112.9	34.3	178	170.3	51.7	238	227.8	69.1	298	285.2	86.5
59	56.5	17.1	119	113.9	34.5	179	171.3	52.0	239	228.7	69.4	299	286.1	86.8
60	57.4	17.4	120	114.8	34.8	180	172.3	52.3	240	229.7	69.7	300	287.1	87.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 6½ Points.

TABLE I.

Difference of Latitude and Departure for 1¾ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.4	20.6	121	113.9	40.8	181	170.4	61.0	241	226.9	81.2
2	01.9	00.7	62	58.4	20.9	122	114.9	41.1	182	171.4	61.3	242	227.9	81.5
3	02.8	01.0	63	59.3	21.2	123	115.8	41.4	183	172.3	61.7	243	228.8	81.9
4	03.8	01.4	64	60.3	21.6	124	116.8	41.8	184	173.2	62.0	244	229.7	82.2
5	04.7	01.7	65	61.2	21.9	125	117.7	42.1	185	174.2	62.3	245	230.7	82.5
6	05.7	02.0	66	62.1	22.2	126	118.6	42.5	186	175.1	62.7	246	231.6	82.9
7	06.6	02.4	67	63.1	22.6	127	119.6	42.8	187	176.1	63.0	247	232.6	83.2
8	07.5	02.7	68	64.0	22.9	128	120.5	43.1	188	177.0	63.3	248	233.5	83.6
9	08.5	03.0	69	65.0	23.3	129	121.5	43.5	189	177.9	63.7	249	234.4	83.9
10	09.4	03.4	70	65.9	23.6	130	122.4	43.8	190	178.9	64.0	250	235.4	84.2
11	10.4	03.7	71	66.9	23.9	131	123.3	44.1	191	179.8	64.4	251	236.3	84.6
12	11.3	04.0	72	67.8	24.3	132	124.3	44.5	192	180.8	64.7	252	237.3	84.9
13	12.2	04.4	73	68.7	24.6	133	125.2	44.8	193	181.7	65.0	253	238.2	85.2
14	13.2	04.7	74	69.7	24.9	134	126.2	45.1	194	182.7	65.4	254	239.1	85.6
15	14.1	05.1	75	70.6	25.3	135	127.1	45.5	195	183.6	65.7	255	240.1	85.9
16	15.1	05.4	76	71.6	25.6	136	128.1	45.8	196	184.5	66.0	256	241.0	86.2
17	16.0	05.7	77	72.5	25.9	137	129.0	46.2	197	185.5	66.4	257	242.0	86.6
18	17.0	06.1	78	73.4	26.3	138	129.9	46.5	198	186.4	66.7	258	242.9	86.9
19	17.9	06.4	79	74.4	26.6	139	130.9	46.8	199	187.4	67.0	259	243.9	87.3
20	18.8	06.7	80	75.3	27.0	140	131.8	47.2	200	188.3	67.4	260	244.8	87.6
21	19.8	07.1	81	76.3	27.3	141	132.8	47.5	201	189.3	67.7	261	245.7	87.9
22	20.7	07.4	82	77.2	27.6	142	133.7	47.8	202	190.2	68.1	262	246.7	88.3
23	21.7	07.8	83	78.2	28.0	143	134.6	48.2	203	191.1	68.4	263	247.6	88.6
24	22.6	08.1	84	79.1	28.3	144	135.6	48.5	204	192.1	68.7	264	248.6	88.9
25	23.5	08.4	85	80.0	28.6	145	136.5	48.9	205	193.0	69.1	265	249.5	89.3
26	24.5	08.8	86	81.0	29.0	146	137.5	49.2	206	194.0	69.4	266	250.5	89.6
27	25.4	09.1	87	81.9	29.3	147	138.4	49.5	207	194.9	69.7	267	251.4	90.0
28	26.4	09.4	88	82.9	29.7	148	139.4	49.9	208	195.8	70.1	268	252.3	90.3
29	27.3	09.8	89	83.8	30.0	149	140.3	50.2	209	196.8	70.4	269	253.3	90.6
30	28.3	10.1	90	84.7	30.3	150	141.2	50.5	210	197.7	70.8	270	254.2	91.0
31	29.2	10.4	91	85.7	30.7	151	142.2	50.9	211	198.7	71.1	271	255.2	91.3
32	30.1	10.8	92	86.6	31.0	152	143.1	51.2	212	199.6	71.4	272	256.1	91.6
33	31.1	11.1	93	87.6	31.3	153	144.1	51.5	213	200.6	71.8	273	257.0	92.0
34	32.0	11.5	94	88.5	31.7	154	145.0	51.9	214	201.5	72.1	274	258.0	92.3
35	33.0	11.8	95	89.5	32.0	155	145.9	52.2	215	202.4	72.4	275	258.9	92.6
36	33.9	12.1	96	90.4	32.3	156	146.9	52.6	216	203.4	72.8	276	259.9	93.0
37	34.8	12.5	97	91.3	32.7	157	147.8	52.9	217	204.3	73.1	277	260.8	93.3
38	35.8	12.8	98	92.3	33.0	158	148.8	53.2	218	205.3	73.4	278	261.8	93.7
39	36.7	13.1	99	93.2	33.4	159	149.7	53.6	219	206.2	73.8	279	262.7	94.0
40	37.7	13.5	100	94.2	33.7	160	150.7	53.9	220	207.1	74.1	280	263.6	94.3
41	38.6	13.8	101	95.1	34.0	161	151.6	54.2	221	208.1	74.5	281	264.6	94.7
42	39.5	14.2	102	96.0	34.4	162	152.5	54.6	222	209.0	74.8	282	265.5	95.0
43	40.5	14.5	103	97.0	34.7	163	153.5	54.9	223	210.0	75.1	283	266.5	95.3
44	41.4	14.8	104	97.9	35.0	164	154.4	55.3	224	210.9	75.5	284	267.4	95.7
45	42.4	15.2	105	98.9	35.4	165	155.4	55.6	225	211.9	75.8	285	268.3	96.0
46	43.3	15.5	106	99.8	35.7	166	156.3	55.9	226	212.8	76.1	286	269.3	96.4
47	44.3	15.8	107	100.7	36.1	167	157.2	56.3	227	213.7	76.5	287	270.2	96.7
48	45.2	16.2	108	101.7	36.4	168	158.2	56.6	228	214.7	76.8	288	271.2	97.0
49	46.1	16.5	109	102.6	36.7	169	159.1	56.9	229	215.6	77.2	289	272.1	97.4
50	47.1	16.8	110	103.6	37.1	170	160.1	57.3	230	216.6	77.5	290	273.0	97.7
51	48.0	17.2	111	104.5	37.4	171	161.0	57.6	231	217.5	77.8	291	274.0	98.0
52	49.0	17.5	112	105.5	37.7	172	161.9	58.0	232	218.4	78.2	292	274.9	98.4
53	49.9	17.9	113	106.4	38.1	173	162.9	58.3	233	219.4	78.5	293	275.9	98.7
54	50.8	18.2	114	107.3	38.4	174	163.8	58.6	234	220.3	78.8	294	276.8	99.0
55	51.8	18.5	115	108.3	38.7	175	164.8	59.0	235	221.3	79.2	295	277.8	99.4
56	52.7	18.9	116	109.2	39.1	176	165.7	59.3	236	222.2	79.5	296	278.7	99.7
57	53.7	19.2	117	110.2	39.4	177	166.7	59.6	237	223.1	79.8	297	279.6	100.1
58	54.6	19.5	118	111.1	39.8	178	167.6	60.0	238	224.1	80.2	298	280.6	100.4
59	55.6	19.9	119	112.0	40.1	179	168.5	60.3	239	225.0	80.5	299	281.5	100.7
60	56.5	20.2	120	113.0	40.4	180	169.5	60.6	240	226.0	80.9	300	282.5	101.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 6¼ Points.

TABLE I.

Difference of Latitude and Departure for 2 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.4	23.3	121	111.8	46.3	181	167.2	69.3	241	222.7	92.2
2	01.9	00.8	62	57.3	23.7	122	112.7	46.7	182	168.2	69.7	242	223.6	92.6
3	02.8	01.2	63	58.2	24.1	123	113.6	47.1	183	169.1	70.0	243	224.5	93.0
4	03.7	01.5	64	59.1	24.5	124	114.6	47.5	184	170.0	70.4	244	225.4	93.4
5	04.6	01.9	65	60.1	24.9	125	115.5	47.8	185	170.9	70.8	245	226.4	93.8
6	05.5	02.3	66	61.0	25.3	126	116.4	48.2	186	171.8	71.2	246	227.3	94.1
7	06.5	02.7	67	61.9	25.6	127	117.3	48.6	187	172.8	71.6	247	228.2	94.5
8	07.4	03.1	68	62.8	26.0	128	118.3	49.0	188	173.7	71.9	248	229.1	94.9
9	08.3	03.4	69	63.8	26.4	129	119.2	49.4	189	174.6	72.3	249	230.1	95.3
10	09.2	03.8	70	64.7	26.8	130	120.1	49.8	190	175.5	72.7	250	231.0	95.6
11	10.2	04.2	71	65.6	27.2	131	121.0	50.1	191	176.5	73.1	251	231.9	96.1
12	11.1	04.6	72	66.5	27.6	132	122.0	50.5	192	177.4	73.5	252	232.8	96.4
13	12.0	05.0	73	67.4	27.9	133	122.9	50.9	193	178.3	73.9	253	233.7	96.8
14	12.9	05.4	74	68.4	28.3	134	123.8	51.3	194	179.2	74.2	254	234.7	97.2
15	13.9	05.7	75	69.3	28.7	135	124.7	51.7	195	180.2	74.6	255	235.6	97.6
16	14.8	06.1	76	70.2	29.1	136	125.7	52.0	196	181.1	75.0	256	236.5	98.0
17	15.7	06.5	77	71.1	29.5	137	126.6	52.4	197	182.0	75.4	257	237.4	98.4
18	16.6	06.9	78	72.1	29.9	138	127.5	52.8	198	182.9	75.8	258	238.4	98.7
19	17.6	07.3	79	73.0	30.2	139	128.4	53.2	199	183.9	76.2	259	239.3	99.1
20	18.5	07.7	80	73.9	30.6	140	129.3	53.6	200	184.8	76.5	260	240.2	99.5
21	19.4	08.0	81	74.8	31.0	141	130.3	54.0	201	185.7	76.9	261	241.1	99.9
22	20.3	08.4	82	75.8	31.4	142	131.2	54.3	202	186.6	77.3	262	242.1	100.3
23	21.3	08.8	83	76.7	31.8	143	132.1	54.7	203	187.6	77.7	263	243.0	100.6
24	22.2	09.2	84	77.6	32.2	144	133.0	55.1	204	188.5	78.1	264	243.9	101.0
25	23.1	09.6	85	78.5	32.5	145	134.0	55.5	205	189.4	78.5	265	244.8	101.4
26	24.0	10.0	86	79.5	32.9	146	134.9	55.9	206	190.3	78.8	266	245.8	101.8
27	24.9	10.3	87	80.4	33.3	147	135.8	56.3	207	191.2	79.2	267	246.7	102.2
28	25.9	10.7	88	81.3	33.7	148	136.7	56.6	208	192.2	79.6	268	247.6	102.6
29	26.8	11.1	89	82.2	34.1	149	137.7	57.0	209	193.1	80.0	269	248.5	102.9
30	27.7	11.5	90	83.2	34.4	150	138.6	57.4	210	194.0	80.4	270	249.5	103.3
31	28.6	11.9	91	84.1	34.8	151	139.5	57.8	211	194.9	80.8	271	250.4	103.7
32	29.6	12.3	92	85.0	35.2	152	140.4	58.2	212	195.9	81.1	272	251.3	104.1
33	30.5	12.6	93	85.9	35.6	153	141.4	58.6	213	196.8	81.5	273	252.2	104.5
34	31.4	13.0	94	86.9	36.0	154	142.3	58.9	214	197.7	81.9	274	253.1	104.9
35	32.3	13.4	95	87.8	36.4	155	143.2	59.3	215	198.6	82.3	275	254.1	105.2
36	33.3	13.8	96	88.7	36.7	156	144.1	59.7	216	199.6	82.7	276	255.0	105.6
37	34.2	14.2	97	89.6	37.1	157	145.1	60.1	217	200.5	83.0	277	255.9	106.0
38	35.1	14.5	98	90.5	37.5	158	146.0	60.5	218	201.4	83.4	278	256.8	106.4
39	36.0	14.9	99	91.5	37.9	159	146.9	60.9	219	202.3	83.8	279	257.8	106.8
40	37.0	15.3	100	92.4	38.3	160	147.8	61.2	220	203.3	84.2	280	258.7	107.2
41	37.9	15.7	101	93.3	38.7	161	148.7	61.6	221	204.2	84.6	281	259.6	107.5
42	38.8	16.1	102	94.2	39.0	162	149.7	62.0	222	205.1	85.0	282	260.5	107.9
43	39.7	16.5	103	95.2	39.4	163	150.6	62.4	223	206.0	85.3	283	261.5	108.3
44	40.7	16.8	104	96.1	39.8	164	151.5	62.8	224	207.0	85.7	284	262.4	108.7
45	41.6	17.2	105	97.0	40.2	165	152.4	63.1	225	207.9	86.1	285	263.3	109.1
46	42.5	17.6	106	97.9	40.6	166	153.4	63.5	226	208.8	86.5	286	264.2	109.5
47	43.4	18.0	107	98.8	41.0	167	154.3	63.9	227	209.7	86.9	287	265.2	109.8
48	44.4	18.4	108	99.8	41.3	168	155.2	64.3	228	210.6	87.3	288	266.1	110.2
49	45.3	18.8	109	160.7	41.7	169	156.1	64.7	229	211.6	87.6	289	267.0	110.6
50	46.2	19.1	110	101.6	42.1	170	157.1	65.1	230	212.5	88.0	290	267.9	111.0
51	47.1	19.5	111	102.6	42.5	171	158.0	65.4	231	213.4	88.4	291	268.9	111.4
52	48.0	19.9	112	103.5	42.9	172	158.9	65.8	232	214.3	88.8	292	269.8	111.7
53	49.0	20.3	113	104.4	43.2	173	159.8	66.2	233	215.3	89.2	293	270.7	112.1
54	49.9	20.7	114	105.3	43.6	174	160.8	66.6	234	216.2	89.6	294	271.6	112.5
55	50.8	21.1	115	106.3	44.0	175	161.7	67.0	235	217.1	89.9	295	272.5	112.9
56	51.7	21.4	116	107.2	44.4	176	162.6	67.4	236	218.0	90.3	296	273.5	113.3
57	52.7	21.8	117	108.1	44.8	177	163.5	67.7	237	219.0	90.7	297	274.4	113.7
58	53.6	22.2	118	109.0	45.2	178	164.5	68.1	238	219.9	91.1	298	275.3	114.0
59	54.5	22.6	119	109.9	45.5	179	165.4	68.5	239	220.8	91.5	299	276.2	114.4
60	55.4	23.0	120	110.9	45.9	180	166.3	68.9	240	221.7	91.8	300	277.2	114.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 6 Points.

TABLE I.

Difference of Latitude and Departure for 2¼ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.1	26.1	121	109.4	51.7	181	163.6	77.4	241	217.9	103.0
2	01.8	00.9	62	56.0	26.5	122	110.3	52.2	182	164.5	77.8	242	218.8	103.5
3	02.7	01.3	63	57.0	26.9	123	111.2	52.6	183	165.4	78.3	243	219.7	103.9
4	03.6	01.7	64	57.9	27.4	124	112.1	53.0	184	166.3	78.7	244	220.6	104.3
5	04.5	02.1	65	58.8	27.8	125	113.0	53.5	185	167.2	79.1	245	221.5	104.8
6	05.4	02.6	66	59.7	28.2	126	113.9	53.9	186	168.1	79.5	246	222.4	105.2
7	06.3	03.0	67	60.6	28.7	127	114.8	54.3	187	169.0	89.0	247	223.3	105.6
8	07.2	03.4	68	61.5	29.1	128	115.7	54.7	188	169.9	80.4	248	224.2	106.1
9	08.1	03.8	69	62.4	29.5	129	116.6	55.2	189	170.9	80.8	249	225.1	106.5
10	09.0	04.3	70	63.3	29.9	130	117.5	55.6	190	171.8	81.3	250	226.0	106.9
11	69.9	04.7	71	64.2	30.4	131	118.4	56.0	191	172.7	81.7	251	226.9	107.3
12	10.8	05.1	72	65.1	30.8	132	119.3	56.5	192	173.6	82.1	252	227.8	107.8
13	11.8	05.6	73	66.0	31.2	133	120.2	56.9	193	174.5	82.5	253	228.7	108.2
14	12.7	06.0	74	66.9	31.6	134	121.1	57.3	194	175.4	83.0	254	229.6	108.6
15	13.6	06.4	75	67.8	32.1	135	122.0	57.7	195	176.3	83.4	255	230.5	109.0
16	14.5	06.8	76	68.7	32.5	136	122.9	58.2	196	177.2	83.8	256	231.4	109.5
17	15.4	07.3	77	69.6	32.9	137	123.8	58.6	197	178.1	84.2	257	232.3	109.9
18	16.3	07.7	78	70.5	33.4	138	124.7	59.0	198	179.0	84.7	258	233.2	110.3
19	17.2	08.1	79	71.4	33.8	139	125.7	59.4	199	179.9	85.1	259	234.1	110.8
20	18.1	08.6	80	72.3	34.2	140	126.6	59.9	200	180.8	85.5	260	235.0	111.2
21	19.0	09.0	81	73.2	34.6	141	127.5	60.3	201	181.7	85.9	261	235.9	111.6
22	19.9	09.4	82	74.1	35.1	142	128.4	60.7	202	182.6	86.4	262	236.8	112.0
23	20.8	09.8	83	75.0	35.5	143	129.3	61.2	203	183.5	86.8	263	237.7	112.5
24	21.7	10.3	84	75.9	35.9	144	130.2	61.6	204	184.4	87.2	264	238.7	112.9
25	22.6	10.7	85	76.8	36.3	145	131.1	62.0	205	185.3	87.7	265	239.6	113.3
26	23.5	11.1	86	77.7	36.8	146	132.0	62.4	206	186.2	88.1	266	240.5	113.7
27	24.4	11.5	87	78.7	37.2	147	132.9	62.9	207	187.1	88.5	267	241.4	114.2
28	25.3	12.0	88	79.6	37.6	148	133.8	63.3	208	188.0	88.9	268	242.3	114.6
29	26.2	12.4	89	80.5	38.1	149	134.7	63.7	209	188.9	89.4	269	243.2	115.0
30	27.1	12.8	90	81.4	38.5	150	135.6	64.1	210	189.8	89.8	270	244.1	115.5
31	28.0	13.3	91	82.3	38.9	151	136.5	64.6	211	190.7	90.2	271	245.0	115.9
32	28.9	13.7	92	83.2	39.3	152	137.4	65.0	212	191.6	90.7	272	245.9	116.3
33	29.8	14.1	93	84.1	39.8	153	138.3	65.4	213	192.6	91.1	273	246.8	116.7
34	30.7	14.5	94	85.0	40.2	154	139.2	65.9	214	193.5	91.5	274	247.7	117.2
35	31.6	15.0	95	85.9	40.6	155	140.1	66.3	215	194.4	91.9	275	248.6	117.6
36	32.5	15.4	96	86.8	41.1	156	141.0	66.7	216	195.3	92.4	276	249.5	118.0
37	33.4	15.8	97	87.7	41.5	157	141.9	67.1	217	196.2	92.8	277	250.4	118.5
38	34.4	16.3	98	88.6	41.9	158	142.8	67.6	218	197.1	93.2	278	251.3	118.9
39	35.3	16.7	99	89.5	42.3	159	143.7	68.0	219	198.0	93.7	279	252.2	119.3
40	36.2	17.1	100	90.4	42.8	160	144.6	68.4	220	198.9	94.1	280	253.1	119.7
41	37.1	17.5	101	91.3	43.2	161	145.5	68.8	221	199.8	94.5	281	254.0	120.2
42	38.0	18.0	102	92.2	43.6	162	146.4	69.3	222	200.7	94.9	282	254.9	120.6
43	38.9	18.4	103	93.1	44.1	163	147.3	69.7	223	201.6	95.4	283	255.8	121.0
44	39.8	18.8	104	94.0	44.5	164	148.3	70.1	224	202.5	95.8	284	256.7	121.5
45	40.7	19.2	105	94.9	44.9	165	149.2	70.6	225	203.4	96.2	285	257.6	121.9
46	41.6	19.7	106	95.8	45.3	166	150.1	71.0	226	204.3	96.6	286	258.5	122.3
47	42.5	20.1	107	96.7	45.8	167	151.0	71.4	227	205.2	97.1	287	259.4	122.7
48	43.4	20.5	108	97.6	46.2	168	151.9	71.8	228	206.1	97.5	288	260.3	123.2
49	44.3	21.0	109	98.5	46.6	169	152.8	72.3	229	207.0	97.9	289	261.3	123.6
50	45.2	21.4	110	99.4	47.0	170	153.7	72.7	230	207.9	98.4	290	262.2	124.0
51	46.1	21.8	111	100.3	47.5	171	154.6	73.1	231	208.8	98.8	291	263.1	124.4
52	47.0	22.2	112	101.2	47.9	172	155.5	73.6	232	209.7	99.2	292	264.0	124.9
53	47.9	22.7	113	102.2	48.3	173	156.4	74.0	233	210.6	99.6	293	264.9	125.3
54	48.8	23.1	114	103.1	48.7	174	157.3	74.4	234	211.5	100.1	294	265.8	125.7
55	49.7	23.5	115	104.0	49.2	175	158.2	74.8	235	212.4	100.5	295	266.7	126.2
56	50.6	23.9	116	104.9	49.6	176	159.1	75.3	236	213.3	100.9	296	267.6	126.6
57	51.5	24.4	117	105.8	50.0	177	160.0	75.7	237	214.2	101.4	297	268.5	127.0
58	52.4	24.8	118	106.7	50.5	178	160.9	76.1	238	215.1	101.8	298	269.4	127.4
59	53.3	25.2	119	107.6	50.9	179	161.8	76.5	239	216.1	102.2	299	270.3	127.9
60	54.2	25.7	120	108.5	51.3	180	162.7	77.0	240	217.0	102.6	300	271.2	128.3
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 5¾ Points.

TABLE I.

Difference of Latitude and Departure for 2½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	53.8	28.8	121	106.7	57.0	181	159.6	85.3	241	212.5	113.6
2	01.8	00.9	62	54.7	29.2	122	107.6	57.5	182	160.5	85.8	242	213.4	114.1
3	02.6	01.4	63	55.6	29.7	123	108.5	58.0	183	161.4	86.3	243	214.3	114.6
4	03.5	01.9	64	56.4	30.2	124	109.4	58.4	184	162.3	86.7	244	215.2	115.0
5	04.4	02.4	65	57.3	30.6	125	110.2	58.9	185	163.2	87.2	245	216.1	115.5
6	05.3	02.8	66	58.2	31.1	126	111.1	59.4	186	164.0	87.7	246	217.0	116.0
7	06.2	03.3	67	59.1	31.6	127	112.0	59.9	187	164.9	88.1	247	217.8	116.4
8	07.1	03.8	68	60.0	32.1	128	112.9	60.3	188	165.8	88.6	248	218.7	116.9
9	07.9	04.2	69	60.9	32.5	129	113.8	60.8	189	166.7	89.1	249	219.6	117.4
10	08.8	04.7	70	61.7	33.0	130	114.7	61.3	190	167.6	89.6	250	220.5	117.8
11	09.7	05.2	71	62.6	33.5	131	115.5	61.7	191	168.5	90.0	251	221.4	118.3
12	10.6	05.7	72	63.5	33.9	132	116.4	62.2	192	169.3	90.5	252	222.2	118.8
13	11.5	06.1	73	64.4	34.4	133	117.3	62.7	193	170.2	91.0	253	223.1	119.3
14	12.3	06.6	74	65.3	34.9	134	118.2	63.2	194	171.1	91.4	254	224.0	119.7
15	13.2	07.1	75	66.1	35.4	135	119.1	63.6	195	172.0	91.9	255	224.9	120.2
16	14.1	07.5	76	67.0	35.8	136	119.9	64.1	196	172.9	92.4	256	225.8	120.7
17	15.0	08.0	77	67.9	36.3	137	120.8	64.6	197	173.7	92.9	257	226.7	121.1
18	15.9	08.5	78	68.8	36.8	138	121.7	65.0	198	174.6	93.3	258	227.5	121.6
19	16.8	09.0	79	69.7	37.2	139	122.6	65.5	199	175.5	93.8	259	228.4	122.1
20	17.6	09.4	80	70.6	37.7	140	123.5	66.0	200	176.4	94.3	260	229.3	122.6
21	18.5	09.9	81	71.4	38.2	141	124.4	66.5	201	177.3	94.7	261	230.2	123.0
22	19.4	10.4	82	72.3	38.6	142	125.2	66.9	202	178.2	95.2	262	231.1	123.5
23	20.3	10.8	83	73.2	39.1	143	126.1	67.4	203	179.0	95.7	263	231.9	124.0
24	21.2	11.3	84	74.1	39.6	144	127.0	67.9	204	179.9	96.2	264	232.8	124.4
25	22.1	11.8	85	75.0	40.1	145	127.9	68.3	205	180.8	96.6	265	233.7	124.9
26	22.9	12.3	86	75.9	40.5	146	128.8	68.8	206	181.7	97.1	266	234.6	125.4
27	23.8	12.7	87	76.7	41.0	147	129.6	69.3	207	182.6	97.6	267	235.5	125.9
28	24.7	13.2	88	77.6	41.5	148	130.5	69.8	208	183.4	98.0	268	236.4	126.3
29	25.6	13.7	89	78.5	41.9	149	131.4	70.2	209	184.3	98.5	269	237.2	126.8
30	26.5	14.1	90	79.4	42.4	150	132.3	70.7	210	185.2	99.0	270	238.1	127.3
31	27.3	14.6	91	80.3	42.9	151	133.2	71.2	211	186.1	99.5	271	239.0	127.7
32	28.2	15.1	92	81.1	43.4	152	134.1	71.6	212	187.0	99.9	272	239.9	128.2
33	29.1	15.6	93	82.0	43.8	153	134.9	72.1	213	187.8	100.4	273	240.8	128.7
34	30.0	16.0	94	82.9	44.3	154	135.8	72.6	214	188.7	100.9	274	241.7	129.2
35	30.9	16.5	95	83.8	44.8	155	136.7	73.1	215	189.6	101.3	275	242.5	129.6
36	31.8	17.0	96	84.7	45.2	156	137.6	73.5	216	190.5	101.8	276	243.4	130.1
37	32.6	17.4	97	85.6	45.7	157	138.5	74.0	217	191.4	102.3	277	244.3	130.6
38	33.5	17.9	98	86.4	46.2	158	139.3	74.5	218	192.3	102.8	278	245.2	131.0
39	34.4	18.4	99	87.3	46.7	159	140.2	74.9	219	193.1	103.2	279	246.1	131.5
40	35.3	18.9	100	88.2	47.1	160	141.1	75.4	220	194.0	103.7	280	246.9	132.0
41	36.2	19.3	101	89.1	47.6	161	142.0	75.9	221	194.9	104.2	281	247.8	132.5
42	37.0	19.8	102	90.0	48.1	162	142.9	76.4	222	195.8	104.6	282	248.7	132.9
43	37.9	20.3	103	90.8	48.5	163	143.8	76.8	223	196.7	105.1	283	249.6	133.4
44	38.8	20.7	104	91.7	49.0	164	144.6	77.3	224	197.6	105.6	284	250.5	133.9
45	39.7	21.2	105	92.6	49.5	165	145.5	77.8	225	198.4	106.1	285	251.4	134.3
46	40.6	21.7	106	93.5	50.0	166	146.4	78.2	226	199.3	106.5	286	252.2	134.8
47	41.5	22.2	107	94.4	50.4	167	147.3	78.7	227	200.2	107.0	287	253.1	135.3
48	42.3	22.6	108	95.3	50.9	168	148.2	79.2	228	201.1	107.5	288	254.0	135.8
49	43.2	23.1	109	96.1	51.4	169	149.0	79.7	229	202.0	107.9	289	254.9	136.2
50	44.1	23.6	110	97.0	51.8	170	149.9	80.1	230	202.8	108.4	290	255.8	136.7
51	45.0	24.0	111	97.9	52.3	171	150.8	80.6	231	203.7	108.9	291	256.6	137.2
52	45.9	24.5	112	98.8	52.8	172	151.7	81.1	232	204.6	109.4	292	257.5	137.6
53	46.7	25.0	113	99.7	53.3	173	152.6	81.5	233	205.5	109.8	293	258.4	138.1
54	47.6	25.5	114	100.5	53.7	174	153.5	82.0	234	206.4	110.3	294	259.3	138.6
55	48.5	25.9	115	101.4	54.2	175	154.3	82.5	235	207.3	110.8	295	260.2	139.1
56	49.4	26.4	116	102.3	54.7	176	155.2	83.0	236	208.1	111.2	296	261.1	139.5
57	50.3	26.9	117	103.2	55.1	177	156.1	83.4	237	209.0	111.7	297	261.9	140.0
58	51.2	27.3	118	104.1	55.6	178	157.0	83.9	238	209.9	112.2	298	262.8	140.5
59	52.0	27.8	119	105.0	56.1	179	157.9	84.4	239	210.8	112.7	299	263.7	140.9
60	52.9	28.3	120	105.8	56.6	180	158.8	84.8	240	211.7	113.1	300	264.6	141.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 5½ Points.

TABLE I.

Difference of Latitude and Departure for 2¾ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.8	62.2	181	155.3	93.0	241	206.7	123.9
2	01.7	01.0	62	53.2	31.9	122	104.6	62.7	182	156.1	93.6	242	207.6	124.4
3	02.6	01.5	63	54.0	32.4	123	105.5	63.2	183	157.0	94.1	243	208.4	124.9
4	03.4	02.1	64	54.9	32.9	124	106.4	63.7	184	157.8	94.6	244	209.3	125.4
5	04.3	02.6	65	55.8	33.4	125	107.2	64.3	185	158.7	95.1	245	210.1	125.9
6	05.1	03.1	66	56.6	33.9	126	108.1	64.8	186	159.5	95.6	246	211.0	126.5
7	06.0	03.6	67	57.5	34.4	127	108.9	65.3	187	160.4	96.1	247	211.9	127.0
8	06.9	04.1	68	58.3	35.9	128	109.8	65.8	188	161.2	96.6	248	212.7	127.5
9	07.7	04.6	69	59.2	35.5	129	110.6	66.3	189	162.1	97.2	249	213.6	128.0
10	08.6	05.1	70	60.0	36.0	130	111.5	66.8	190	163.0	97.7	250	214.4	128.5
11	09.4	05.7	71	60.9	36.5	131	112.4	67.3	191	163.8	98.2	251	215.3	129.0
12	10.3	06.2	72	61.8	37.0	132	113.2	67.9	192	164.7	98.7	252	216.1	129.5
13	11.2	06.7	73	62.6	37.5	133	114.1	68.4	193	165.5	99.2	253	217.0	130.1
14	12.0	07.2	74	63.5	38.0	134	114.9	68.9	194	166.4	99.7	254	217.9	130.6
15	12.9	07.7	75	64.3	38.6	135	115.8	69.4	195	167.3	100.2	255	218.7	131.1
16	13.7	08.2	76	65.2	39.1	136	116.6	69.9	196	168.1	100.8	256	219.6	131.6
17	14.6	08.7	77	66.0	39.6	137	117.5	70.4	197	169.0	101.3	257	220.4	132.1
18	15.4	09.3	78	66.9	40.1	138	118.4	70.9	198	169.8	101.8	258	221.3	132.6
19	16.3	09.8	79	67.8	40.6	139	119.2	71.5	199	170.7	102.3	259	222.2	133.1
20	17.2	10.3	80	68.6	41.1	140	120.1	72.0	200	171.5	102.8	260	223.0	133.7
21	18.0	10.8	81	69.5	41.6	141	120.9	72.5	201	172.4	103.3	261	223.9	134.2
22	18.9	11.3	82	70.3	42.1	142	121.8	73.0	202	173.3	103.8	262	224.7	134.7
23	19.7	11.8	83	71.2	42.7	143	122.7	73.5	203	174.1	104.4	263	225.6	135.2
24	20.6	12.3	84	72.0	43.2	144	123.5	74.0	204	175.0	104.9	264	226.4	135.7
25	21.4	12.9	85	72.9	43.7	145	124.4	74.5	205	175.8	105.4	265	227.3	136.2
26	22.3	13.4	86	73.8	44.2	146	125.2	75.1	206	176.7	105.9	266	228.2	136.7
27	23.2	13.9	87	74.6	44.7	147	126.1	75.6	207	177.5	106.4	267	229.0	137.3
28	24.0	14.4	88	75.5	45.2	148	126.9	76.1	208	178.4	106.9	268	229.9	137.8
29	24.9	14.9	89	76.3	45.7	149	127.8	76.6	209	179.3	107.4	269	230.7	138.3
30	25.7	15.4	90	77.2	46.3	150	128.7	77.1	210	180.1	108.0	270	231.6	138.8
31	26.6	15.9	91	78.1	46.8	151	129.5	77.6	211	181.0	108.5	271	232.4	139.3
32	27.4	16.5	92	78.9	47.3	152	130.4	78.1	212	181.8	109.0	272	233.3	139.8
33	28.3	17.0	93	79.8	47.8	153	131.2	78.7	213	182.7	109.5	273	234.2	140.3
34	29.2	17.5	94	80.6	48.3	154	132.1	79.2	214	183.5	110.0	274	235.0	140.9
35	30.0	18.0	95	81.5	48.8	155	132.9	79.7	215	184.4	110.5	275	235.9	141.4
36	30.9	18.5	96	82.3	49.3	156	133.8	80.2	216	185.3	111.0	276	236.7	141.9
37	31.7	19.0	97	83.2	49.9	157	134.7	80.7	217	186.1	111.6	277	237.6	142.4
38	32.6	19.5	98	84.1	50.4	158	135.5	81.2	218	187.0	112.1	278	238.4	142.9
39	33.5	20.1	99	84.9	50.9	159	136.4	81.7	219	187.8	112.6	279	239.3	143.4
40	34.3	20.6	100	85.8	51.4	160	137.2	82.3	220	188.7	113.1	280	240.2	143.9
41	35.2	21.1	101	86.6	51.9	161	138.1	82.8	221	189.6	113.6	281	241.0	144.5
42	36.0	21.6	102	87.5	52.4	162	138.9	83.3	222	190.4	114.1	282	241.9	145.0
43	36.9	22.1	103	88.3	52.9	163	139.8	83.8	223	191.3	114.6	283	242.7	145.5
44	37.7	22.6	104	89.2	53.5	164	140.7	84.3	224	192.1	115.2	284	243.6	146.0
45	38.6	23.1	105	90.1	54.0	165	141.5	84.8	225	193.0	115.7	285	244.4	146.5
46	39.5	23.6	106	90.9	54.5	166	142.4	85.3	226	193.8	116.2	286	245.3	147.0
47	40.3	24.2	107	91.8	55.0	167	143.2	85.8	227	194.7	116.7	287	246.2	147.5
48	41.2	24.7	108	92.6	55.5	168	144.1	86.4	228	195.6	117.2	288	247.0	148.1
49	42.0	25.2	109	93.5	56.0	169	145.0	86.9	229	196.4	117.7	289	247.9	148.6
50	42.9	25.7	110	94.3	56.5	170	145.8	87.4	230	197.3	118.2	290	248.7	149.1
51	43.7	26.2	111	95.2	57.1	171	146.7	87.9	231	198.1	118.8	291	249.6	149.6
52	44.6	26.7	112	96.1	57.6	172	147.5	88.4	232	199.0	119.3	292	250.5	150.1
53	45.5	27.2	113	96.9	58.1	173	148.4	88.9	233	199.8	119.8	293	251.3	150.6
54	46.3	27.8	114	97.8	58.6	174	149.2	89.4	234	200.7	120.3	294	252.2	151.1
55	47.2	28.3	115	98.6	59.1	175	150.1	90.0	235	201.6	120.8	295	253.0	151.7
56	48.0	28.8	116	99.5	59.6	176	151.0	90.5	236	202.4	121.3	296	253.9	152.2
57	48.9	29.3	117	100.4	60.1	177	151.8	91.0	237	203.3	121.8	297	254.7	152.7
58	49.7	29.8	118	101.2	60.7	178	152.7	91.5	238	204.1	122.4	298	255.6	153.2
59	50.6	30.3	119	102.1	61.2	179	153.5	92.0	239	205.0	122.9	299	256.5	153.7
60	51.5	30.8	120	102.9	61.7	180	154.4	92.5	240	205.9	123.4	300	257.3	154.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 5¼ Points.

TABLE I.

Difference of Latitude and Departure for 3 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	50.7	33.9	121	100.6	67.2	181	150.5	100.6	241	200.4	133.9
2	01.7	01.1	62	51.5	34.4	122	101.4	67.8	182	151.3	101.1	242	201.2	134.4
3	02.5	01.7	63	52.4	35.0	123	102.3	68.3	183	152.2	101.7	243	202.0	135.0
4	03.3	02.2	64	53.2	35.6	124	103.1	68.9	184	153.0	102.2	244	202.9	135.6
5	04.2	02.8	65	54.0	36.1	125	103.9	69.4	185	153.8	102.8	245	203.7	136.1
6	05.0	03.3	66	54.9	36.7	126	104.8	70.0	186	154.6	103.3	246	204.5	136.7
7	05.8	03.9	67	55.7	37.2	127	105.6	70.6	187	155.5	103.9	247	205.4	137.2
8	06.7	04.4	68	56.5	37.8	128	106.4	71.1	188	156.3	104.4	248	206.2	137.8
9	07.5	05.0	69	57.4	38.3	129	107.3	71.7	189	157.1	105.0	249	207.0	138.3
10	08.3	05.6	70	58.2	38.9	130	108.1	72.2	190	158.0	105.6	250	207.9	138.9
11	09.1	06.1	71	59.0	39.4	131	108.9	72.8	191	158.8	106.1	251	208.7	139.4
12	10.0	06.7	72	59.9	40.0	132	109.7	73.3	192	159.6	106.7	252	209.5	140.0
13	10.8	07.2	73	60.7	40.6	133	110.6	73.9	193	160.5	107.2	253	210.4	140.6
14	11.6	07.8	74	61.5	41.1	134	111.4	74.4	194	161.3	107.8	254	211.2	141.1
15	12.5	08.3	75	62.4	41.7	135	112.2	75.0	195	162.1	108.3	255	212.0	141.7
16	13.3	08.9	76	63.2	42.2	136	113.1	75.6	196	163.0	108.9	256	212.9	142.2
17	14.1	09.4	77	64.0	42.8	137	113.9	76.1	197	163.8	109.4	257	213.7	142.8
18	15.0	10.0	78	64.8	43.3	138	114.7	76.7	198	164.6	110.0	258	214.5	143.3
19	15.8	10.6	79	65.7	43.9	139	115.6	77.2	199	165.5	110.6	259	215.3	143.9
20	16.6	11.1	80	66.5	44.4	140	116.4	77.8	200	166.3	111.1	260	216.2	144.4
21	17.5	11.7	81	67.3	45.0	141	117.2	78.3	201	167.1	111.7	261	217.0	145.0
22	18.3	12.2	82	68.2	45.6	142	118.1	78.9	202	168.0	112.2	262	217.8	145.6
23	19.1	12.8	83	69.0	46.1	143	118.9	79.4	203	168.8	112.8	263	218.7	146.1
24	20.0	13.3	84	69.8	46.7	144	119.7	80.0	204	169.6	113.3	264	219.5	146.7
25	20.8	13.9	85	70.7	47.2	145	120.6	80.6	205	170.4	113.9	265	220.3	147.2
26	21.6	14.4	86	71.5	47.8	146	121.4	81.1	206	171.3	114.4	266	221.2	147.8
27	22.4	15.0	87	72.3	48.3	147	122.2	81.7	207	172.1	115.0	267	222.0	148.3
28	23.3	15.6	88	73.2	48.9	148	123.1	82.2	208	172.9	115.6	268	222.8	148.9
29	24.1	16.1	89	74.0	49.4	149	123.9	82.8	209	173.8	116.1	269	223.7	149.4
30	24.9	16.7	90	74.8	50.0	150	124.7	83.3	210	174.6	116.7	270	224.5	150.0
31	25.8	17.2	91	75.7	50.6	151	125.5	83.9	211	175.4	117.2	271	225.3	150.6
32	26.6	17.8	92	76.5	51.1	152	126.4	84.4	212	176.3	117.8	272	226.2	151.1
33	27.4	18.3	93	77.3	51.7	153	127.2	85.0	213	177.1	118.3	273	227.0	151.7
34	28.3	18.9	94	78.2	52.2	154	128.0	85.6	214	177.9	118.9	274	227.8	152.2
35	29.1	19.4	95	79.0	52.8	155	128.9	86.1	215	178.8	119.4	275	228.6	152.8
36	29.9	20.0	96	79.8	53.3	156	129.7	86.7	216	179.6	120.0	276	229.5	153.3
37	30.8	20.6	97	80.6	53.9	157	130.5	87.2	217	180.4	120.6	277	230.3	153.9
38	31.6	21.1	98	81.5	54.4	158	131.4	87.8	218	181.3	121.1	278	231.1	154.4
39	32.4	21.7	99	82.3	55.0	159	132.2	88.3	219	182.1	121.7	279	232.0	155.0
40	33.3	22.2	100	83.1	55.6	160	133.0	88.9	220	182.9	122.2	280	232.8	155.6
41	34.1	22.8	101	84.0	56.1	161	133.9	89.4	221	183.7	122.8	281	233.6	156.1
42	34.9	23.3	102	84.8	56.7	162	134.7	90.0	222	184.6	123.3	282	234.5	156.7
43	35.8	23.9	103	85.6	57.2	163	135.5	90.6	223	185.4	123.9	283	235.3	157.2
44	36.6	24.4	104	86.5	57.8	164	136.4	91.1	224	186.2	124.4	284	236.1	157.8
45	37.4	25.0	105	87.3	58.3	165	137.2	91.7	225	187.1	125.0	285	237.0	158.3
46	38.2	25.6	106	88.1	58.9	166	138.0	92.2	226	187.9	125.6	286	237.8	158.9
47	39.1	26.1	107	89.0	59.4	167	138.9	92.8	227	188.7	126.1	287	238.6	159.4
48	39.9	26.7	108	89.8	60.0	168	139.7	93.3	228	189.6	126.7	288	239.5	160.0
49	40.7	27.2	109	90.6	60.6	169	140.5	93.9	229	190.4	127.2	289	240.3	160.6
50	41.6	27.8	110	91.5	61.1	170	141.3	94.4	230	191.2	127.8	290	241.1	161.1
51	42.4	28.3	111	92.3	61.7	171	142.2	95.0	231	192.1	128.3	291	242.0	161.7
52	43.2	28.9	112	93.1	62.2	172	143.0	95.6	232	192.9	128.9	292	242.8	162.2
53	44.1	29.4	113	94.0	62.8	173	143.8	96.1	233	193.7	129.4	293	243.6	162.8
54	44.9	30.0	114	94.8	63.3	174	144.7	96.7	234	194.6	130.0	294	244.4	163.3
55	45.7	30.6	115	95.6	63.9	175	145.5	97.2	235	195.4	130.6	295	245.3	163.9
56	46.6	31.1	116	96.4	64.4	176	146.3	97.8	236	196.2	131.1	296	246.1	164.4
57	47.4	31.7	117	97.3	65.0	177	147.2	98.3	237	197.1	131.7	297	246.9	165.0
58	48.2	32.2	118	98.1	65.6	178	148.0	98.9	238	197.9	132.2	298	247.8	165.6
59	49.1	32.8	119	98.9	66.1	179	148.8	99.4	239	198.7	132.8	299	248.6	166.1
60	49.9	33.3	120	99.8	66.7	180	149.7	100.0	240	199.5	133.3	300	249.4	166.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.

For 5 Points.

TABLE I.

Difference of Latitude and Departure for 3¼ Point.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	49.0	36.3	121	97.2	72.1	181	145.4	107.8	241	193.6	143.6
2	01.6	01.2	62	49.8	36.9	122	98.0	72.7	182	146.2	108.4	242	194.4	144.2
3	02.4	01.8	63	50.6	37.5	123	98.8	73.3	183	147.0	109.0	243	195.2	144.8
4	03.2	02.4	64	51.4	38.1	124	99.6	73.9	184	147.8	109.6	244	196.0	145.4
5	04.0	03.0	65	52.2	38.7	125	100.4	74.5	185	148.6	110.2	245	196.8	146.0
6	04.8	03.6	66	53.0	39.3	126	101.2	75.1	186	149.4	110.8	246	197.6	146.5
7	05.6	04.2	67	53.8	39.9	127	102.0	75.7	187	150.2	111.4	247	198.4	147.1
8	06.4	04.8	68	54.6	40.5	128	102.8	76.3	188	151.0	112.0	248	199.2	147.7
9	07.2	05.4	69	55.4	41.1	129	103.6	76.9	189	151.8	112.6	249	200.0	148.3
10	08.0	06.0	70	56.2	41.7	130	104.4	77.4	190	152.6	113.2	250	200.8	148.9
11	08.8	06.6	71	57.0	42.3	131	105.2	78.0	191	153.4	113.8	251	201.6	149.5
12	09.6	07.1	72	57.8	42.9	132	106.0	78.6	192	154.2	114.4	252	202.4	150.1
13	10.4	07.7	73	58.6	43.5	133	106.8	79.2	193	155.0	115.0	253	203.2	150.7
14	11.2	08.3	74	59.4	44.1	134	107.6	79.8	194	155.8	115.6	254	204.0	151.3
15	12.0	08.9	75	60.2	44.7	135	108.4	80.4	195	156.6	116.2	255	204.8	151.9
16	12.9	09.5	76	61.0	45.3	136	109.2	81.0	196	157.4	116.8	256	205.6	152.5
17	13.7	10.1	77	61.8	45.9	137	110.0	81.6	197	158.2	117.4	257	206.4	153.1
18	14.5	10.7	78	62.6	46.5	138	110.8	82.2	198	159.0	118.0	258	207.2	153.7
19	15.3	11.3	79	63.4	47.1	139	111.6	82.8	199	159.8	118.5	259	208.0	154.3
20	16.1	11.9	80	64.3	47.7	140	112.4	83.4	200	160.6	119.1	260	208.8	154.9
21	16.9	12.5	81	65.1	48.3	141	113.2	84.0	201	161.4	119.7	261	209.6	155.5
22	17.7	13.1	82	65.9	48.9	142	114.0	84.6	202	162.2	120.3	262	210.4	156.1
23	18.5	13.7	83	66.7	49.4	143	114.9	85.2	203	163.0	120.9	263	211.2	156.7
24	19.3	14.3	84	67.5	50.0	144	115.7	85.8	204	163.9	121.5	264	212.0	157.3
25	20.1	14.9	85	68.3	50.6	145	116.5	86.4	205	164.7	122.1	265	212.8	157.9
26	20.9	15.5	86	69.1	51.2	146	117.3	87.0	206	165.5	122.7	266	213.6	158.5
27	21.7	16.1	87	69.9	51.8	147	118.1	87.6	207	166.3	123.3	267	214.5	159.1
28	22.5	16.7	88	70.7	52.4	148	118.9	88.2	208	167.1	123.9	268	215.3	159.6
29	23.3	17.3	89	71.5	53.0	149	119.7	88.8	209	167.9	124.5	269	216.1	160.2
30	24.1	17.9	90	72.3	53.6	150	120.5	89.4	210	168.7	125.1	270	216.9	160.8
31	24.9	18.5	91	73.1	54.2	151	121.3	90.0	211	169.5	125.7	271	217.7	161.4
32	25.7	19.1	92	73.9	54.8	152	122.1	90.5	212	170.3	126.3	272	218.5	162.0
33	26.5	19.7	93	74.7	55.4	153	122.9	91.1	213	171.1	126.9	273	219.3	162.6
34	27.3	20.3	94	75.5	56.0	154	123.7	91.7	214	171.9	127.5	274	220.1	163.2
35	28.1	20.9	95	76.3	56.6	155	124.5	92.3	215	172.7	128.1	275	220.9	163.8
36	28.9	21.4	96	77.1	57.2	156	125.3	92.9	216	173.5	128.7	276	221.7	164.4
37	29.7	22.0	97	77.9	57.8	157	126.1	93.5	217	174.3	129.3	277	222.5	165.0
38	30.5	22.6	98	78.7	58.4	158	126.9	94.1	218	175.1	129.9	278	223.3	165.6
39	31.3	23.2	99	79.5	59.0	159	127.7	94.7	219	175.9	130.5	279	224.1	166.2
40	32.1	23.8	100	80.3	59.6	160	128.5	95.3	220	176.7	131.1	280	224.9	166.8
41	32.9	24.4	101	81.1	60.2	161	129.3	95.9	221	177.5	131.7	281	225.7	167.4
42	33.7	25.0	102	81.9	60.8	162	130.1	96.5	222	178.3	132.2	282	226.5	168.0
43	34.5	25.6	103	82.7	61.4	163	130.9	97.1	223	179.1	132.8	283	227.3	168.6
44	35.3	26.2	104	83.5	62.0	164	131.7	97.7	224	179.9	133.4	284	228.1	169.2
45	36.1	26.8	105	84.3	62.6	165	132.5	98.3	225	180.7	134.0	285	228.9	169.8
46	36.9	27.4	106	85.1	63.1	166	133.3	98.9	226	181.5	134.6	286	229.7	170.4
47	37.7	28.0	107	85.9	63.7	167	134.1	99.5	227	182.3	135.2	287	230.5	171.0
48	38.6	28.6	108	86.7	64.3	168	134.9	100.1	228	183.1	135.8	288	231.3	171.6
49	39.4	29.2	109	87.5	64.9	169	135.7	100.7	229	183.9	136.4	289	232.1	172.2
50	40.2	29.8	110	88.4	65.5	170	136.5	101.3	230	184.7	137.0	290	232.9	172.8
51	41.0	30.4	111	89.2	66.1	171	137.3	101.9	231	185.5	137.6	291	233.7	173.3
52	41.8	31.0	112	90.0	66.7	172	138.1	102.5	232	186.3	138.2	292	234.5	173.9
53	42.6	31.6	113	90.8	67.3	173	138.9	103.1	233	187.1	138.8	293	235.3	174.5
54	43.4	32.2	114	91.6	67.9	174	139.8	103.7	234	187.9	139.4	294	236.1	175.1
55	44.2	32.8	115	92.4	68.5	175	140.6	104.2	235	188.8	140.0	295	236.9	175.7
56	45.0	33.4	116	93.2	69.1	176	141.4	104.8	236	189.6	140.6	296	237.7	176.3
57	45.8	34.0	117	94.0	69.7	177	142.2	105.4	237	190.4	141.2	297	238.5	176.9
58	46.6	34.6	118	94.8	70.3	178	143.0	106.0	238	191.2	141.8	298	239.4	177.5
59	47.4	35.1	119	95.6	70.9	179	143.8	106.6	239	192.0	142.4	299	240.2	178.1
60	48.2	35.7	120	96.4	71.5	180	144.6	107.2	240	192.8	143.0	300	241.0	178.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 4¾ Points.

TABLE I.

Difference of Latitude and Departure for 3½ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	47.1	38.7	121	93.5	76.8	181	139.9	114.8	241	186.3	152.9
2	01.5	01.3	62	47.9	39.3	122	94.3	77.4	182	140.7	115.5	242	187.1	153.5
3	02.3	01.9	63	48.7	40.0	123	95.1	78.0	183	141.5	116.1	243	187.8	154.2
4	03.1	02.5	64	49.5	40.6	124	95.8	78.7	184	142.2	116.7	244	188.6	154.8
5	03.9	03.2	65	50.2	41.2	125	96.6	79.3	185	143.0	117.4	245	189.4	155.4
6	04.6	03.8	66	51.0	41.9	126	97.4	79.9	186	143.8	118.0	246	190.2	156.1
7	05.4	04.4	67	51.8	42.5	127	98.2	80.6	187	144.5	118.6	247	190.9	156.7
8	06.2	05.1	68	52.6	43.1	128	98.9	81.2	188	145.3	119.3	248	191.7	157.3
9	07.0	05.7	69	53.3	43.8	129	99.7	81.8	189	146.1	119.9	249	192.5	158.0
10	07.7	06.3	70	54.1	44.4	130	100.5	82.5	190	146.9	120.5	250	193.2	158.6
11	08.5	07.0	71	54.9	45.0	131	101.3	83.1	191	147.6	121.2	251	194.0	159.2
12	09.3	07.6	72	55.7	45.7	132	102.0	83.7	192	148.4	121.8	252	194.8	159.9
13	10.0	08.2	73	56.4	46.3	133	102.8	84.4	193	149.2	122.4	253	195.6	160.5
14	10.8	08.9	74	57.2	46.9	134	103.6	85.0	194	150.0	123.1	254	196.3	161.1
15	11.6	09.5	75	58.0	47.6	135	104.4	85.6	195	150.7	123.7	255	197.1	161.8
16	12.4	10.1	76	58.7	48.2	136	105.1	86.3	196	151.5	124.3	256	197.9	162.4
17	13.1	10.8	77	59.5	48.8	137	105.9	86.9	197	152.3	125.0	257	198.7	163.0
18	13.9	11.4	78	60.3	49.5	138	106.7	87.5	198	153.1	125.6	258	199.4	163.7
19	14.7	12.0	79	61.1	50.1	139	107.4	88.2	199	153.8	126.2	259	200.2	164.3
20	15.5	12.7	80	61.8	50.7	140	108.2	88.8	200	154.6	126.9	260	201.0	164.9
21	16.2	13.3	81	62.6	51.4	141	109.0	89.4	201	155.4	127.5	261	201.8	165.6
22	17.0	14.0	82	63.4	52.0	142	109.8	90.1	202	156.1	128.1	262	202.5	166.2
23	17.8	14.6	83	64.2	52.7	143	110.5	90.7	203	156.9	128.8	263	203.3	166.8
24	18.6	15.2	84	64.9	53.3	144	111.3	91.3	204	157.7	129.4	264	204.1	167.5
25	19.3	15.9	85	65.7	53.9	145	112.1	92.0	205	158.5	130.0	265	204.8	168.1
26	20.1	16.5	86	66.5	54.6	146	112.9	92.6	206	159.2	130.7	266	205.6	168.7
27	20.9	17.1	87	67.2	55.2	147	113.6	93.3	207	160.0	131.3	267	206.4	169.4
28	21.6	17.8	88	68.0	55.8	148	114.4	93.9	208	160.8	132.0	268	207.2	170.0
29	22.4	18.4	89	68.8	56.5	149	115.2	94.5	209	161.6	132.6	269	207.9	170.6
30	23.2	19.0	90	69.6	57.1	150	115.9	95.2	210	162.3	133.2	270	208.7	171.3
31	24.0	19.7	91	70.3	57.7	151	116.7	95.8	211	163.1	133.9	271	209.5	171.9
32	24.7	20.3	92	71.1	58.4	152	117.5	96.4	212	163.9	134.5	272	210.3	172.6
33	25.5	20.9	93	71.9	59.0	153	118.3	97.1	213	164.6	135.1	273	211.0	173.2
34	26.3	21.6	94	72.7	59.6	154	119.0	97.7	214	165.4	135.8	274	211.8	173.8
35	27.1	22.2	95	73.4	60.3	155	119.8	98.3	215	166.2	136.4	275	212.6	174.5
36	27.8	22.8	96	74.2	60.9	156	120.6	99.0	216	167.0	137.0	276	213.3	175.1
37	28.6	23.5	97	75.0	61.5	157	121.4	99.6	217	167.7	137.7	277	214.1	175.7
38	29.4	24.1	98	75.7	62.2	158	122.1	100.2	218	168.5	138.3	278	214.9	176.4
39	30.1	24.7	99	76.5	62.8	159	122.9	100.9	219	169.3	138.9	279	215.7	177.0
40	30.9	25.4	100	77.3	63.4	160	123.7	101.5	220	170.1	139.6	280	216.4	177.6
41	31.7	26.0	101	78.1	64.1	161	124.4	102.1	221	170.8	140.2	281	217.2	178.3
42	32.5	26.6	102	78.8	64.7	162	125.2	102.8	222	171.6	140.8	282	218.0	178.9
43	33.2	27.3	103	79.6	65.3	163	126.0	103.4	223	172.4	141.5	283	218.8	179.5
44	34.0	27.9	104	80.4	66.0	164	126.8	104.0	224	173.1	142.1	284	219.5	180.2
45	34.8	28.5	105	81.2	66.6	165	127.5	104.7	225	173.9	142.7	285	220.3	180.8
46	35.6	29.2	106	81.9	67.2	166	128.3	105.3	226	174.7	143.4	286	221.1	181.4
47	36.3	29.8	107	82.7	67.9	167	129.1	105.9	227	175.5	144.0	287	221.8	182.1
48	37.1	30.4	108	83.5	68.5	168	129.9	106.6	228	176.2	144.6	288	222.6	182.7
49	37.9	31.1	109	84.3	69.1	169	130.6	107.2	229	177.0	145.3	289	223.4	183.3
50	38.6	31.7	110	85.0	69.8	170	131.4	107.8	230	177.8	145.9	290	224.2	184.0
51	39.4	32.3	111	85.8	70.4	171	132.2	108.5	231	178.6	146.5	291	224.9	184.6
52	40.2	33.0	112	86.6	71.0	172	133.0	109.1	232	179.3	147.2	292	225.7	185.2
53	41.0	33.6	113	87.3	71.7	173	133.7	109.7	233	180.1	147.8	293	226.5	185.9
54	41.7	34.3	114	88.1	72.3	174	134.5	110.4	234	180.9	148.4	294	227.3	186.5
55	42.5	34.9	115	88.9	73.0	175	135.3	111.0	235	181.7	149.1	295	228.0	187.1
56	43.3	35.5	116	89.7	73.6	176	136.0	111.6	236	182.4	149.7	296	228.8	187.8
57	44.1	36.2	117	90.4	74.2	177	136.8	112.3	237	183.2	150.3	297	229.6	188.4
58	44.8	36.8	118	91.2	74.9	178	137.6	112.9	238	184.0	151.0	298	230.4	189.0
59	45.6	37.4	119	92.0	75.5	179	138.4	113.6	239	184.7	151.6	299	231.1	189.7
60	46.4	38.1	120	92.8	76.1	180	139.1	114.2	240	185.5	152.3	300	231.9	190.3
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 4½ Points.

TABLE I.

Difference of Latitude and Departure for 3¾ Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	45.2	41.0	121	89.6	81.3	181	134.1	121.5	241	178.6	161.8
2	01.5	01.3	62	45.9	41.6	122	90.4	81.9	182	134.8	122.2	242	179.3	162.5
3	02.2	02.0	63	46.7	42.3	123	91.1	82.6	183	135.6	122.9	243	180.0	163.2
4	03.0	02.7	64	47.4	43.0	124	91.9	83.3	184	136.3	123.6	244	180.8	163.8
5	03.7	03.4	65	48.2	43.6	125	92.6	83.9	185	137.1	124.2	245	181.5	164.5
6	04.4	04.0	66	48.9	44.3	126	93.4	84.6	186	137.8	124.9	246	182.3	165.2
7	05.2	04.7	67	49.6	45.0	127	94.1	85.3	187	138.6	125.6	247	183.0	165.9
8	05.9	05.4	68	50.4	45.7	128	94.8	86.0	188	139.3	126.2	248	183.8	166.5
9	06.7	06.0	69	51.1	46.3	129	95.6	86.6	189	140.0	126.9	249	184.5	167.2
10	07.4	06.7	70	51.9	47.0	130	96.3	87.3	190	140.8	127.6	250	185.2	167.9
11	08.2	07.4	71	52.6	47.7	131	97.1	88.0	191	141.5	128.3	251	186.0	168.5
12	08.9	08.1	72	53.3	48.3	132	97.8	88.6	192	142.3	128.9	252	186.7	169.2
13	09.6	08.7	73	54.1	49.0	133	98.5	89.3	193	143.0	129.6	253	187.5	169.9
14	10.4	09.4	74	54.8	49.7	134	99.3	90.0	194	143.7	130.3	254	188.2	170.6
15	11.1	10.1	75	55.6	50.4	135	100.0	90.7	195	144.5	130.9	255	188.9	171.2
16	11.9	10.7	76	56.3	51.0	136	100.8	91.3	196	145.2	131.6	256	189.7	171.9
17	12.6	11.4	77	57.0	51.7	137	101.5	92.0	197	146.0	132.3	257	190.4	172.6
18	13.3	12.1	78	57.8	52.4	138	102.2	92.7	198	146.7	133.0	258	191.2	173.2
19	14.1	12.8	79	58.5	53.0	139	103.0	93.3	199	147.4	133.6	259	191.9	173.9
20	14.8	13.4	80	59.3	53.7	140	103.7	94.0	200	148.2	134.3	260	192.6	174.6
21	15.6	14.1	81	60.0	54.4	141	104.5	94.7	201	148.9	135.0	261	193.4	175.3
22	16.3	14.8	82	60.8	55.1	142	105.2	95.4	202	149.7	135.6	262	194.1	175.9
23	17.0	15.4	83	61.5	55.7	143	106.0	96.0	203	150.4	136.3	263	194.9	176.6
24	17.8	16.1	84	62.2	56.4	144	106.7	96.7	204	151.1	137.0	264	195.6	177.3
25	18.5	16.8	85	63.0	57.1	145	107.4	97.4	205	151.9	137.7	265	196.3	178.0
26	19.3	17.5	86	63.7	57.7	146	108.2	98.0	206	152.6	138.3	266	197.1	178.6
27	20.0	18.1	87	64.5	58.4	147	108.9	98.7	207	153.4	139.0	267	197.8	179.3
28	20.7	18.8	88	65.2	59.1	148	109.7	99.4	208	154.1	139.7	268	198.6	180.0
29	21.5	19.5	89	65.9	59.8	149	110.4	100.1	209	154.9	140.3	269	199.3	180.6
30	22.2	20.1	90	66.7	60.4	150	111.1	100.7	210	155.6	141.0	270	200.1	181.3
31	23.0	20.8	91	67.4	61.1	151	111.9	101.4	211	156.3	141.7	271	200.8	182.0
32	23.7	21.5	92	68.2	61.8	152	112.6	102.1	212	157.1	142.4	272	201.5	182.7
33	24.4	22.2	93	68.9	62.4	153	113.4	102.7	213	157.8	143.0	273	202.3	183.3
34	25.2	22.8	94	69.6	63.1	154	114.1	103.4	214	158.6	143.7	274	203.0	184.0
35	25.9	23.5	95	70.4	63.8	155	114.8	104.1	215	159.3	144.4	275	203.8	184.7
36	26.7	24.2	96	71.1	64.5	156	115.6	104.8	216	160.0	145.0	276	204.5	185.3
37	27.4	24.8	97	71.9	65.1	157	116.3	105.4	217	160.8	145.7	277	205.2	186.0
38	28.2	25.5	98	72.6	65.8	158	117.1	106.1	218	161.5	146.4	278	206.0	186.7
39	28.9	26.2	99	73.3	66.5	159	117.8	106.8	219	162.3	147.1	279	206.7	187.4
40	29.6	26.9	100	74.1	67.2	160	118.5	107.4	220	163.0	147.7	280	207.5	188.0
41	30.4	27.5	101	74.8	67.8	161	119.3	108.1	221	163.7	148.4	281	208.2	188.7
42	31.1	28.2	102	75.6	68.5	162	120.0	108.8	222	164.5	149.1	282	208.9	189.4
43	31.9	28.9	103	76.3	69.2	163	120.8	109.5	223	165.2	149.7	283	209.7	190.0
44	32.6	29.5	104	77.1	69.8	164	121.5	110.1	224	166.0	150.4	284	210.4	190.7
45	33.3	30.2	105	77.8	70.5	165	122.3	110.8	225	166.7	151.1	285	211.2	191.4
46	34.1	30.9	106	78.5	71.2	166	123.0	111.5	226	167.4	151.8	286	211.9	192.1
47	34.8	31.6	107	79.3	71.8	167	123.7	112.1	227	168.2	152.4	287	212.6	192.7
48	35.6	32.2	108	80.0	72.5	168	124.5	112.8	228	168.9	153.1	288	213.4	193.4
49	36.3	32.9	109	80.8	73.2	169	125.2	113.5	229	169.7	153.8	289	214.1	194.1
50	37.0	33.6	110	81.5	73.9	170	126.0	114.2	230	170.4	154.5	290	214.9	194.7
51	37.8	34.2	111	82.2	74.5	171	126.7	114.8	231	171.2	155.1	291	215.6	195.4
52	38.5	34.9	112	83.0	75.2	172	127.4	115.5	232	171.9	155.8	292	216.4	196.1
53	39.3	35.6	113	83.7	75.9	173	128.2	116.2	233	172.6	156.5	293	217.1	196.8
54	40.0	36.3	114	84.5	76.5	174	128.9	116.8	234	173.4	157.1	294	217.8	197.4
55	40.7	36.9	115	85.2	77.2	175	129.7	117.5	235	174.1	157.8	295	218.6	198.1
56	41.5	37.6	116	85.9	77.9	176	130.4	118.2	236	174.9	158.5	296	219.3	198.8
57	42.2	38.3	117	86.7	78.6	177	131.1	118.9	237	175.6	159.1	297	220.1	199.4
58	43.0	38.9	118	87.4	79.2	178	131.9	119.5	238	176.3	159.8	298	220.8	200.1
59	43.7	39.6	119	88.2	79.9	179	132.6	120.2	239	177.1	160.5	299	221.5	200.8
60	44.5	40.3	120	88.9	80.6	180	133.4	120.9	240	177.8	161.2	300	222.3	201.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 4¼ Points.

TABLE I.

Difference of Latitude and Departure for 4 Points.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	122	86.3	86.3	182	128.7	128.7	242	171.1	171.1
3	02.1	02.1	63	44.5	44.5	123	87.0	87.0	183	129.4	129.4	243	171.8	171.8
4	02.8	02.8	64	45.3	45.3	124	87.7	87.7	184	130.1	130.1	244	172.5	172.5
5	03.5	03.5	65	46.0	46.0	125	88.4	88.4	185	130.8	130.8	245	173.2	173.2
6	04.2	04.2	66	46.7	46.7	126	89.1	89.1	186	131.5	131.5	246	173.9	173.9
7	04.9	04.9	67	47.4	47.4	127	89.8	89.8	187	132.2	132.2	247	174.7	174.7
8	05.7	05.7	68	48.1	48.1	128	90.5	90.5	188	132.9	132.9	248	175.4	175.4
9	06.4	06.4	69	48.8	48.8	129	91.2	91.2	189	133.6	133.6	249	176.1	176.1
10	07.1	07.1	70	49.5	49.5	130	91.9	91.9	190	134.3	134.3	250	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	132	93.3	93.3	192	135.8	135.8	252	178.2	178.2
13	09.2	09.2	73	51.6	51.6	133	94.0	94.0	193	136.5	136.5	253	178.9	178.9
14	09.9	09.9	74	52.3	52.3	134	94.8	94.8	194	137.2	137.2	254	179.6	179.6
15	10.6	10.6	75	53.0	53.0	135	95.5	95.5	195	137.9	137.9	255	180.3	180.3
16	11.3	11.3	76	53.7	53.7	136	96.2	96.2	196	138.6	138.6	256	181.0	181.0
17	12.0	12.0	77	54.4	54.4	137	96.9	96.9	197	139.3	139.3	257	181.7	181.7
18	12.7	12.7	78	55.2	55.2	138	97.6	97.6	198	140.0	140.0	258	182.4	182.4
19	13.4	13.4	79	55.9	55.9	139	98.3	98.3	199	140.7	140.7	259	183.1	183.1
20	14.1	14.1	80	56.6	56.6	140	99.0	99.0	200	141.4	141.4	260	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	142	100.4	100.4	202	142.8	142.8	262	185.3	185.3
23	16.3	16.3	83	58.7	58.7	143	101.1	101.1	203	143.5	143.5	263	186.0	186.0
24	17.0	17.0	84	59.4	59.4	144	101.8	101.8	204	144.2	144.2	264	186.7	186.7
25	17.7	17.7	85	60.1	60.1	145	102.5	102.5	205	145.0	145.0	265	187.4	187.4
26	18.4	18.4	86	60.8	60.8	146	103.2	103.2	206	145.7	145.7	266	188.1	188.1
27	19.1	19.1	87	61.5	61.5	147	103.9	103.9	207	146.4	146.4	267	188.8	188.8
28	19.8	19.8	88	62.2	62.2	148	104.7	104.7	208	147.1	147.1	268	189.5	189.5
29	20.5	20.5	89	62.9	62.9	149	105.4	105.4	209	147.8	147.8	269	190.2	190.2
30	21.2	21.2	90	63.6	63.6	150	106.1	106.1	210	148.5	148.5	270	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	152	107.5	107.5	212	149.9	149.9	272	192.3	192.3
33	23.3	23.3	93	65.8	65.8	153	108.2	108.2	213	150.6	150.6	273	193.0	193.0
34	24.0	24.0	94	66.5	66.5	154	108.9	108.9	214	151.3	151.3	274	193.7	193.7
35	24.7	24.7	95	67.2	67.2	155	109.6	109.6	215	152.0	152.0	275	194.5	194.5
36	25.5	25.5	96	67.9	67.9	156	110.3	110.3	216	152.7	152.7	276	195.2	195.2
37	26.2	26.2	97	68.6	68.6	157	111.0	111.0	217	153.4	153.4	277	195.9	195.9
38	26.9	26.9	98	69.3	69.3	158	111.7	111.7	218	154.1	154.1	278	196.6	196.6
39	27.6	27.6	99	70.0	70.0	159	112.4	112.4	219	154.9	154.9	279	197.3	197.3
40	28.3	28.3	100	70.7	70.7	160	113.1	113.1	220	155.6	155.6	280	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	102	72.1	72.1	162	114.5	114.5	222	157.0	157.0	282	199.4	199.4
43	30.4	30.4	103	72.8	72.8	163	115.3	115.3	223	157.7	157.7	283	200.1	200.1
44	31.1	31.1	104	73.5	73.5	164	116.0	116.0	224	158.4	158.4	284	200.8	200.8
45	31.8	31.8	105	74.2	74.2	165	116.7	116.7	225	159.1	159.1	285	201.5	201.5
46	32.5	32.5	106	75.0	75.0	166	117.4	117.4	226	159.8	159.8	286	202.2	202.2
47	33.2	33.2	107	75.7	75.7	167	118.1	118.1	227	160.5	160.5	287	202.9	202.9
48	33.9	33.9	108	76.4	76.4	168	118.8	118.8	228	161.2	161.2	288	203.6	203.6
49	34.6	34.6	109	77.1	77.1	169	119.5	119.5	229	161.9	161.9	289	204.3	204.3
50	35.4	35.4	110	77.8	77.8	170	120.2	120.2	230	162.6	162.6	290	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	112	79.2	79.2	172	121.6	121.6	232	164.0	164.0	292	206.5	206.5
53	37.5	37.5	113	79.9	79.9	173	122.3	122.3	233	164.8	164.8	293	207.2	207.2
54	38.2	38.2	114	80.6	80.6	174	123.0	123.0	234	165.5	165.5	294	207.9	207.9
55	38.9	38.9	115	81.3	81.3	175	123.7	123.7	235	166.2	166.2	295	208.6	208.6
56	39.6	39.6	116	82.0	82.0	176	124.4	124.4	236	166.9	166.9	296	209.3	209.3
57	40.3	40.3	117	82.7	82.7	177	125.2	125.2	237	167.6	167.6	297	210.0	210.0
58	41.0	41.0	118	83.4	83.4	178	125.9	125.9	238	168.3	168.3	298	210.7	210.7
59	41.7	41.7	119	84.1	84.1	179	126.6	126.6	239	169.0	169.0	299	211.4	211.4
60	42.4	42.4	120	84.8	84.8	180	127.3	127.3	240	169.7	169.7	300	212.1	212.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

TABLE II.

Difference of Latitude and Departure for 1 Degree.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.0	61	61.0	01.1	121	121.0	02.1	181	181.0	03.2	241	241.0	04.2
2	02.0	00.0	62	62.0	01.1	122	122.0	02.1	182	182.0	03.2	242	242.0	04.2
3	03.0	00.1	63	63.0	01.1	123	123.0	02.1	183	183.0	03.2	243	243.0	04.2
4	04.0	00.1	64	64.0	01.1	124	124.0	02.2	184	184.0	03.2	244	244.0	04.3
5	05.0	00.1	65	65.0	01.1	125	125.0	02.2	185	185.0	03.2	245	245.0	04.3
6	06.0	00.1	66	66.0	01.2	126	126.0	02.2	186	186.0	03.2	246	246.0	04.3
7	07.0	00.1	67	67.0	01.2	127	127.0	02.2	187	187.0	03.3	247	247.0	04.3
8	08.0	00.1	68	68.0	01.2	128	128.0	02.2	188	188.0	03.3	248	248.0	04.3
9	09.0	00.2	69	69.0	01.2	129	129.0	02.2	189	189.0	03.3	249	249.0	04.3
10	10.0	00.2	70	70.0	01.2	130	130.0	02.3	190	190.0	03.3	250	250.0	04.4
11	11.0	00.2	71	71.0	01.2	131	131.0	02.3	191	191.0	03.3	251	251.0	04.4
12	12.0	00.2	72	72.0	01.3	132	132.0	02.3	192	192.0	03.4	252	252.0	04.4
13	13.0	00.2	73	73.0	01.3	133	133.0	02.3	193	193.0	03.4	253	253.0	04.4
14	14.0	00.2	74	74.0	01.3	134	134.0	02.3	194	194.0	03.4	254	254.0	04.4
15	15.0	00.3	75	75.0	01.3	135	135.0	02.4	195	195.0	03.4	255	255.0	04.4
16	16.0	00.3	76	76.0	01.3	136	136.0	02.4	196	196.0	03.4	256	256.0	04.5
17	17.0	00.3	77	77.0	01.3	137	137.0	02.4	197	197.0	03.4	257	257.0	04.5
18	18.0	00.3	78	78.0	01.4	138	138.0	02.4	198	198.0	03.5	258	258.0	04.5
19	19.0	00.3	79	79.0	01.4	139	139.0	02.4	199	199.0	03.5	259	259.0	04.5
20	20.0	00.3	80	80.0	01.4	140	140.0	02.4	200	200.0	03.5	260	260.0	04.5
21	21.0	00.4	81	81.0	01.4	141	141.0	02.5	201	201.0	03.5	261	261.0	04.5
22	22.0	00.4	82	82.0	01.4	142	142.0	02.5	202	202.0	03.5	262	262.0	04.6
23	23.0	00.4	83	83.0	01.4	143	143.0	02.5	203	203.0	03.5	263	263.0	04.6
24	24.0	00.4	84	84.0	01.5	144	144.0	02.5	204	204.0	03.6	264	264.0	04.6
25	25.0	00.4	85	85.0	01.5	145	145.0	02.5	205	205.0	03.6	265	265.0	04.6
26	26.0	00.5	86	86.0	01.5	146	146.0	02.5	206	206.0	03.6	266	266.0	04.6
27	27.0	00.5	87	87.0	01.5	147	147.0	02.6	207	207.0	03.6	267	267.0	04.7
28	28.0	00.5	88	88.0	01.5	148	148.0	02.6	208	208.0	03.6	268	268.0	04.7
29	29.0	00.5	89	89.0	01.6	149	149.0	02.6	209	209.0	03.7	269	269.0	04.7
30	30.0	00.5	90	90.0	01.6	150	150.0	02.6	210	210.0	03.7	270	270.0	04.7
31	31.0	00.5	91	91.0	01.6	151	151.0	02.6	211	211.0	03.7	271	271.0	04.7
32	32.0	00.6	92	92.0	01.6	152	152.0	02.7	212	212.0	03.7	272	272.0	04.7
33	33.0	00.6	93	93.0	01.6	153	153.0	02.7	213	213.0	03.7	273	273.0	04.8
34	34.0	00.6	94	94.0	01.6	154	154.0	02.7	214	214.0	03.7	274	274.0	04.8
35	35.0	00.6	95	95.0	01.7	155	155.0	02.7	215	215.0	03.8	275	275.0	04.8
36	36.0	00.6	96	96.0	01.7	156	156.0	02.7	216	216.0	03.8	276	276.0	04.8
37	37.0	00.6	97	97.0	01.7	157	157.0	02.7	217	217.0	03.8	277	277.0	04.8
38	38.0	00.7	98	98.0	01.7	158	158.0	02.8	218	218.0	03.8	278	278.0	04.9
39	39.0	00.7	99	99.0	01.7	159	159.0	02.8	219	219.0	03.8	279	279.0	04.9
40	40.0	00.7	100	100.0	01.7	160	160.0	02.8	220	220.0	03.8	280	280.0	04.9
41	41.0	00.7	101	101.0	01.8	161	161.0	02.8	221	221.0	03.9	281	281.0	04.9
42	42.0	00.7	102	102.0	01.8	162	162.0	02.8	222	222.0	03.9	282	282.0	04.9
43	43.0	00.8	103	103.0	01.8	163	163.0	02.8	223	223.0	03.9	283	283.0	04.9
44	44.0	00.8	104	104.0	01.8	164	164.0	02.9	224	224.0	03.9	284	284.0	05.0
45	45.0	00.8	105	105.0	01.8	165	165.0	02.9	225	225.0	03.9	285	285.0	05.0
46	46.0	00.8	106	106.0	01.8	166	166.0	02.9	226	226.0	03.9	286	286.0	05.0
47	47.0	00.8	107	107.0	01.9	167	167.0	02.9	227	227.0	04.0	287	287.0	05.0
48	48.0	00.8	108	108.0	01.9	168	168.0	02.9	228	228.0	04.0	288	288.0	05.0
49	49.0	00.9	109	109.0	01.9	169	169.0	02.9	229	229.0	04.0	289	289.0	05.0
50	50.0	00.9	110	110.0	01.9	170	170.0	03.0	230	230.0	04.0	290	290.0	05.1
51	51.0	00.9	111	111.0	01.9	171	171.0	03.0	231	231.0	04.0	291	291.0	05.1
52	52.0	00.9	112	112.0	02.0	172	172.0	03.0	232	232.0	04.0	292	292.0	05.1
53	53.0	00.9	113	113.0	02.0	173	173.0	03.0	233	233.0	04.1	293	293.0	05.1
54	54.0	00.9	114	114.0	02.0	174	174.0	03.0	234	234.0	04.1	294	294.0	05.1
55	55.0	01.0	115	115.0	02.0	175	175.0	03.1	235	235.0	04.1	295	295.0	05.1
56	56.0	01.0	116	116.0	02.0	176	176.0	03.1	236	236.0	04.1	296	296.0	05.2
57	57.0	01.0	117	117.0	02.0	177	177.0	03.1	237	237.0	04.1	297	297.0	05.2
58	58.0	01.0	118	118.0	02.1	178	178.0	03.1	238	238.0	04.2	298	298.0	05.2
59	59.0	01.0	119	119.0	02.1	179	179.0	03.1	239	239.0	04.2	299	299.0	05.2
60	60.0	01.0	120	120.0	02.1	180	180.0	03.1	240	240.0	04.2	300	300.0	05.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 89 Degrees.

TABLE II.

Difference of Latitude and Departure for 2 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.0	61	61.0	02.1	121	120.9	04.2	181	180.9	06.3	241	240.9	08.4
2	02.0	00.1	62	62.0	02.2	122	121.9	04.3	182	181.9	06.4	242	241.9	08.4
3	03.0	00.1	63	63.0	02.2	123	122.9	04.3	183	182.9	06.4	243	242.9	08.5
4	04.0	00.1	64	64.0	02.2	124	123.9	04.3	184	183.9	06.4	244	243.9	08.5
5	05.0	00.2	65	65.0	02.3	125	124.9	04.4	185	184.9	06.5	245	244.9	08.6
6	06.0	00.2	66	66.0	02.3	126	125.9	04.4	186	185.9	06.5	246	245.8	08.6
7	07.0	00.2	67	67.0	02.3	127	126.9	04.4	187	186.9	06.5	247	246.8	08.6
8	08.0	00.3	68	68.0	02.4	128	127.9	04.5	188	187.9	06.6	248	247.8	08.7
9	09.0	00.3	69	69.0	02.4	129	128.9	04.5	189	188.9	06.6	249	248.8	08.7
10	10.0	00.3	70	70.0	02.4	130	129.9	04.5	190	189.9	06.6	250	249.8	08.7
11	11.0	00.4	71	71.0	02.5	131	130.9	04.6	191	190.9	06.7	251	250.8	08.8
12	12.0	00.4	72	72.0	02.5	132	131.9	04.6	192	191.9	06.7	252	251.8	08.8
13	13.0	00.5	73	73.0	02.5	133	132.9	04.6	193	192.9	06.7	253	252.8	08.8
14	14.0	00.5	74	74.0	02.6	134	133.9	04.7	194	193.9	06.8	254	253.8	08.9
15	15.0	00.5	75	75.0	02.6	135	134.9	04.7	195	194.9	06.8	255	254.8	08.9
16	16.0	00.6	76	76.0	02.7	136	135.9	04.7	196	195.9	06.8	256	255.8	08.9
17	17.6	00.6	77	77.0	02.7	137	136.9	04.8	197	196.9	06.9	257	256.8	09.0
18	18.0	00.6	78	78.0	02.7	138	137.9	04.8	198	197.9	06.9	258	257.8	09.0
19	19.0	00.7	79	79.0	02.8	139	138.9	04.9	199	198.9	06.9	259	258.8	09.0
20	20.0	00.7	80	80.0	02.8	140	139.9	04.9	200	199.9	07.0	260	259.8	09.1
21	21.0	00.7	81	81.0	02.8	141	140.9	04.9	201	200.9	07.0	261	260.8	09.1
22	22.0	00.8	82	81.9	02.9	142	141.9	05.0	202	201.9	07.0	262	261.8	09.1
23	23.0	00.8	83	82.9	02.9	143	142.9	05.0	203	202.9	07.1	263	262.8	09.2
24	24.0	00.8	84	83.9	02.9	144	143.9	05.0	204	203.9	07.1	264	263.8	09.2
25	25.0	00.9	85	84.9	03.0	145	144.9	05.1	205	204.9	07.2	265	264.8	09.2
26	26.0	00.9	86	85.9	03.0	146	145.9	05.1	206	205.9	07.2	266	265.8	09.3
27	27.0	00.9	87	86.9	03.0	147	146.9	05.1	207	206.9	07.2	267	266.8	09.3
28	28.0	01.0	88	87.9	03.1	148	147.9	05.2	208	207.9	07.3	268	267.8	09.4
29	29.0	01.0	89	88.9	03.1	149	148.9	05.2	209	208.9	07.3	269	268.8	09.4
30	30.0	01.0	90	89.9	03.1	150	149.9	05.2	210	209.9	07.3	270	269.8	09.4
31	31.0	01.1	91	90.9	03.2	151	150.9	05.3	211	210.9	07.4	271	270.8	09.5
32	32.0	01.1	92	91.9	03.2	152	151.9	05.3	212	211.9	07.4	272	271.8	09.5
33	33.0	01.2	93	92.9	03.2	153	152.9	05.3	213	212.9	07.4	273	272.8	09.5
34	34.0	01.2	94	93.9	03.3	154	153.9	05.4	214	213.9	07.5	274	273.8	09.6
35	35.0	01.2	95	94.9	03.3	155	154.9	05.4	215	214.9	07.5	275	274.8	09.6
36	36.0	01.3	96	95.9	03.4	156	155.9	05.4	216	215.9	07.5	276	275.8	09.6
37	37.0	01.3	97	96.9	03.4	157	156.9	05.5	217	216.9	07.6	277	276.8	09.7
38	38.0	01.3	98	97.9	03.4	158	157.9	05.5	218	217.9	07.6	278	277.8	09.7
39	39.0	01.4	99	98.9	03.5	159	158.9	05.5	219	218.9	07.6	279	278.8	09.7
40	40.0	01.4	100	99.9	03.5	160	159.9	05.6	220	219.9	07.7	280	279.8	09.8
41	41.0	01.4	101	100.9	03.5	161	160.9	05.6	221	220.9	07.7	281	280.8	09.8
42	42.0	01.5	102	101.9	03.6	162	161.9	05.7	222	221.9	07.7	282	281.8	09.8
43	43.0	01.5	103	102.9	03.6	163	162.9	05.7	223	222.9	07.8	283	282.8	09.9
44	44.0	01.5	104	103.9	03.6	164	163.9	05.7	224	223.9	07.8	284	283.8	09.9
45	45.0	01.6	105	104.9	03.7	165	164.9	05.8	225	224.9	07.9	285	284.8	09.9
46	46.0	01.6	106	105.9	03.7	166	165.9	05.8	226	225.9	07.9	286	285.8	10.0
47	47.0	01.6	107	106.9	03.7	167	166.9	05.8	227	226.9	07.9	287	286.8	10.0
48	48.0	01.7	108	107.9	03.8	168	167.9	05.9	228	227.9	08.0	288	287.8	10.1
49	49.0	01.7	109	108.9	03.8	169	168.9	05.9	229	228.9	08.0	289	288.8	10.1
50	50.0	01.7	110	109.9	03.8	170	169.9	05.9	230	229.9	08.0	290	289.8	10.1
51	51.0	01.8	111	110.9	03.9	171	170.9	06.0	231	230.9	08.1	291	290.8	10.2
52	52.0	01.8	112	111.9	03.9	172	171.9	06.0	232	231.9	08.1	292	291.8	10.2
53	53.0	01.8	113	112.9	03.9	173	172.9	06.0	233	232.9	08.1	293	292.8	10.2
54	54.0	01.9	114	113.9	04.0	174	173.9	06.1	234	233.9	08.2	294	293.8	10.3
55	55.0	01.9	115	114.9	04.0	175	174.9	06.1	235	234.9	08.2	295	294.8	10.3
56	56.0	02.0	116	115.9	04.0	176	175.9	06.1	236	235.9	08.2	296	295.8	10.3
57	57.0	02.0	117	116.9	04.1	177	176.9	06.2	237	236.9	08.3	297	296.8	10.4
58	58.0	02.0	118	117.9	04.1	178	177.9	06.2	238	237.9	08.3	298	297.8	10.4
59	59.0	02.1	119	118.9	04.2	179	178.9	06.2	239	238.9	08.3	299	298.8	10.4
60	60.0	02.1	120	119.9	04.2	180	179.9	06.3	240	239.9	08.4	300	299.8	10.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 88 Degrees.

TABLE II.

Difference of Latitude and Departure for 3 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.9	03.2	121	120.8	06.3	181	180.8	09.5	241	240.7	12.6
2	02.0	00.1	62	61.9	03.2	122	121.8	06.4	182	181.8	09.5	242	241.7	12.7
3	03.0	00.2	63	62.9	03.3	123	122.8	06.4	183	182.7	09.6	243	242.7	12.7
4	04.0	00.2	64	63.9	03.3	124	123.8	06.5	184	183.7	09.6	244	243.7	12.8
5	05.0	00.3	65	64.9	03.4	125	124.8	06.5	185	184.7	09.7	245	244.7	12.8
6	06.0	00.3	66	65.9	03.5	126	125.8	06.6	186	185.7	09.7	246	245.7	12.9
7	07.0	00.4	67	66.9	03.5	127	126.8	06.6	187	186.7	09.8	247	246.7	12.9
8	08.0	00.4	68	67.9	03.6	128	127.8	06.7	188	187.7	09.8	248	247.7	13.0
9	09.0	00.5	69	68.9	03.6	129	128.8	06.8	189	188.7	09.9	249	248.7	13.0
10	10.0	00.5	70	69.9	03.7	130	129.8	06.8	190	189.7	09.9	250	249.7	13.1
11	11.0	00.6	71	70.9	03.7	131	130.8	06.9	191	190.7	10.0	251	250.7	13.1
12	12.0	00.6	72	71.9	03.8	132	131.8	06.9	192	191.7	10.0	252	251.7	13.2
13	13.0	00.7	73	72.9	03.8	133	132.8	07.0	193	192.7	10.1	253	252.7	13.2
14	14.0	00.7	74	73.9	03.9	134	133.8	07.0	194	193.7	10.2	254	253.7	13.3
15	15.0	00.8	75	74.9	03.9	135	134.8	07.1	195	194.7	10.2	255	254.7	13.3
16	16.0	00.8	76	75.9	04.0	136	135.8	07.1	196	195.7	10.3	256	255.6	13.4
17	17.0	00.9	77	76.9	04.0	137	136.8	07.2	197	196.7	10.3	257	256.6	13.5
18	18.0	00.9	78	77.9	04.1	138	137.8	07.2	198	197.7	10.4	258	257.6	13.5
19	19.0	01.0	79	78.9	04.1	139	138.8	07.3	199	198.7	10.4	259	258.6	13.6
20	20.0	01.0	80	79.9	04.2	140	139.8	07.3	200	199.7	10.5	260	259.6	13.6
21	21.0	01.1	81	80.9	04.2	141	140.8	07.4	201	200.7	10.5	261	260.6	13.7
22	22.0	01.2	82	81.9	04.3	142	141.8	07.4	202	201.7	10.6	262	261.6	13.7
23	23.0	01.2	83	82.9	04.3	143	142.8	07.5	203	202.7	10.6	263	262.6	13.8
24	24.0	01.3	84	83.9	04.4	144	143.8	07.5	204	203.7	10.7	264	263.6	13.8
25	25.0	01.3	85	84.9	04.4	145	144.8	07.6	205	204.7	10.7	265	264.6	13.9
26	26.0	01.4	86	85.9	04.5	146	145.8	07.6	206	205.7	10.8	266	265.6	13.9
27	27.0	01.4	87	86.9	04.6	147	146.8	07.7	207	206.7	10.8	267	266.6	14.0
28	28.0	01.5	88	87.9	04.6	148	147.8	07.7	208	207.7	10.9	268	267.6	14.0
29	29.0	01.5	89	88.9	04.7	149	148.8	07.8	209	208.7	10.9	269	268.6	14.1
30	30.0	01.6	90	89.9	04.7	150	149.8	07.9	210	209.7	11.0	270	269.6	14.1
31	31.0	01.6	91	90.9	04.8	151	150.8	07.9	211	210.7	11.0	271	270.6	14.2
32	32.0	01.7	92	91.9	04.8	152	151.8	08.0	212	211.7	11.1	272	271.6	14.2
33	33.0	01.7	93	92.9	04.9	153	152.8	08.0	213	212.7	11.1	273	272.6	14.3
34	34.0	01.8	94	93.9	04.9	154	153.8	08.1	214	213.7	11.2	274	273.6	14.3
35	35.0	01.8	95	94.9	05.0	155	154.8	08.1	215	214.7	11.3	275	274.6	14.4
36	36.0	01.9	96	95.9	05.0	156	155.8	08.2	216	215.7	11.3	276	275.6	14.4
37	36.9	01.9	97	96.9	05.1	157	156.8	08.2	217	216.7	11.4	277	276.6	14.5
38	37.9	02.0	98	97.9	05.1	158	157.8	08.3	218	217.7	11.4	278	277.6	14.5
39	38.9	02.0	99	98.9	05.2	159	158.8	08.3	219	218.7	11.5	279	278.6	14.6
40	39.9	02.1	100	99.9	05.2	160	159.8	08.4	220	219.7	11.5	280	279.6	14.7
41	40.9	02.1	101	100.9	05.3	161	160.8	08.4	221	220.7	11.6	281	280.6	14.7
42	41.9	02.2	102	101.9	05.3	162	161.8	08.5	222	221.7	11.6	282	281.6	14.8
43	42.9	02.3	103	102.9	05.4	163	162.8	08.5	223	222.7	11.7	283	282.6	14.8
44	43.9	02.3	104	103.9	05.4	164	163.8	08.6	224	223.7	11.7	284	283.6	14.9
45	44.9	02.4	105	104.9	05.5	165	164.8	08.6	225	224.7	11.8	285	284.6	14.9
46	45.9	02.4	106	105.9	05.5	166	165.8	08.7	226	225.7	11.8	286	285.6	15.0
47	46.9	02.5	107	106.9	05.6	167	166.8	08.7	227	226.7	11.9	287	286.6	15.0
48	47.9	02.5	108	107.9	05.7	168	167.8	08.8	228	227.7	11.9	288	287.6	15.1
49	48.9	02.6	109	108.9	05.7	169	168.8	08.8	229	228.7	12.0	289	288.6	15.1
50	49.9	02.6	110	109.8	05.8	170	169.8	08.9	230	229.7	12.0	290	289.6	15.2
51	50.9	02.7	111	110.8	05.8	171	170.8	08.9	231	230.7	12.1	291	290.6	15.2
52	51.9	02.7	112	111.8	05.9	172	171.8	09.0	232	231.7	12.1	292	291.6	15.3
53	52.9	02.8	113	112.8	05.9	173	172.8	09.1	233	232.7	12.2	293	292.6	15.3
54	53.9	02.8	114	113.8	06.0	174	173.8	09.1	234	233.7	12.2	294	293.6	15.4
55	54.9	02.9	115	114.8	06.0	175	174.8	09.2	235	234.7	12.3	295	294.6	15.4
56	55.9	02.9	116	115.8	06.1	176	175.8	09.2	236	235.7	12.4	296	295.6	15.5
57	56.9	03.0	117	116.8	06.1	177	176.8	09.3	237	236.7	12.4	297	296.6	15.5
58	57.9	03.0	118	117.8	06.2	178	177.8	09.3	238	237.7	12.5	298	297.6	15.6
59	58.9	03.1	119	118.8	06.2	179	178.8	09.4	239	238.7	12.5	299	298.6	15.6
60	59.9	03.1	120	119.8	06.3	180	179.8	09.4	240	239.7	12.6	300	299.6	15.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 87 Degrees.

TABLE II.

Difference of Latitude and Departure for 4 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.9	04.3	121	120.7	08.4	181	180.6	12.6	241	240.4	16.8
2	02.0	00 1	62	61.8	04.3	122	121.7	08.5	182	181.6	12.7	242	241.4	16.9
3	03.0	00.2	63	62.8	04.4	123	122.7	08.6	183	182.6	12.8	243	242.4	17.0
4	04.0	00.3	64	63.8	04.5	124	123.7	08.6	184	183.6	12.8	244	243.4	17.0
5	05.0	00.3	65	64.8	04.5	125	124.7	08.7	185	184.5	12.9	245	244.4	17.1
6	06.0	00.4	66	65.8	04.6	126	125.7	08.8	186	185.5	13.0	246	245.4	17.2
7	07.0	00.5	67	66.8	04.7	127	126.7	08.9	187	186.5	13.0	247	246.4	17.2
8	08.0	00.6	68	67.8	04.7	128	127.7	08.9	188	187 5	13.1	248	247.4	17.3
9	09.0	00.6	69	68.8	04.8	129	128.7	09.0	189	188.5	13.2	249	248.4	17.4
10	10.0	00.7	70	69.8	04.9	130	129.7	09.1	190	189.5	13.3	250	249.4	17.4
11	11.0	00.8	71	70.8	05.0	131	130.7	09.1	191	190.5	13.3	251	250.4	17.5
12	12.0	00.8	72	71.8	05.0	132	131.7	09.2	192	191.5	13.4	252	251.4	17.6
13	13.0	00.9	73	72.8	05.1	133	132.7	09.3	193	192.5	13.5	253	252.4	17.6
14	14.0	01 0	74	73.8	05.2	134	133.7	09.3	194	193.5	13.5	254	253.4	17.7
15	15.0	01.0	75	74.8	05.2	135	134.7	09.4	195	194.5	13.6	255	254.4	17.8
16	16.0	01.1	76	75.8	05.3	136	135.7	09.5	196	195.5	13.7	256	255.4	17.9
17	17.0	01.2	77	76.8	05.4	137	136.7	09.6	197	196.5	13.7	257	256.4	17.9
18	18.0	01.3	78	77.8	05.4	138	137.7	09.6	198	197.5	13.8	258	257.4	18.0
19	19.0	01.3	79	78.8	05.5	139	138.7	09.7	199	198.5	13.9	259	258.4	18.1
20	20.0	01.4	80	79.8	05.6	140	139.7	09.8	200	199.5	14.0	260	259.4	18.1
21	20.9	01.5	81	80.8	05.7	141	140.7	09.8	201	200.5	14.0	261	260.4	18.2
22	21.9	01.5	82	81.8	05.7	142	141.7	09.9	202	201.5	14.1	262	261.4	18.3
23	22.9	01.6	83	82.8	05.8	143	142.7	10.0	203	202.5	14.2	263	262.4	18.3
24	23.9	01.7	84	83.8	05.9	144	143.6	10.0	204	203.5	14.2	264	263.4	18.4
25	24.9	01.7	85	84.8	05.9	145	144.6	10.1	205	204.5	14.3	265	264.4	18.5
26	25.9	01.8	86	85.8	06.0	146	145.6	10.2	206	205.5	14.4	266	265.4	18.6
27	26.9	01.9	87	86.8	06.1	147	146.6	10.3	207	206.5	14.4	267	266.3	18.6
28	27.9	02.0	88	87.8	06.1	148	147.6	10.3	208	207.5	14.5	268	267.3	18.7
29	28.9	02.0	89	88.8	06.2	149	148.6	10.4	209	208.5	14.6	269	268.3	18.8
30	29.9	02.1	90	89.8	06.3	150	149.6	10.5	210	209.5	14.6	270	269.3	18.8
31	30.9	02.2	91	90.8	06.3	151	150.6	10.5	211	210.5	14.7	271	270.3	18.9
32	31.9	02.2	92	91.8	06.4	152	151.6	10.6	212	211.5	14.8	272	271.3	19.0
33	32.9	02.3	93	92.8	06.5	153	152.6	10.7	213	212.5	14.9	273	272.3	19.0
34	33.9	02.4	94	93.8	06.6	154	153.6	10.7	214	213.5	14.9	274	273.3	19.1
35	34.9	02.4	95	94.8	06.6	155	154.6	10.8	215	214.5	15.0	275	274.3	19.2
36	35.9	02.5	96	95.8	06.7	156	155.6	10.9	216	215.5	15.1	276	275.3	19.3
37	36.9	02.6	97	96.8	06.8	157	156.6	11.0	217	216.5	15.1	277	276.3	19.3
38	37.9	02.7	98	97.8	06.8	158	157.6	11.0	218	217.5	15.2	278	277.3	19.4
39	38.9	02.7	99	98.8	06.9	159	158.6	11.1	219	218.5	15.3	279	278.3	19.5
40	39.9	02.8	100	99.8	07.0	160	159.6	11.2	220	219.5	15.3	280	279.3	19.5
41	40.9	02.9	101	100.8	07.0	161	160.6	11.2	221	220.5	15.4	281	280.3	19.6
42	41.9	02.9	102	101.8	07.1	162	161.6	11.3	222	221.5	15.5	282	281.3	19.7
43	42.9	03.0	103	102.7	07.2	163	162.6	11.4	223	222.5	15.6	283	282.3	19.7
44	43.9	03.1	104	103.7	07.3	164	163.6	11.4	224	223.5	15.6	284	283.3	19.8
45	44.9	03.1	105	104.7	07.3	165	164.6	11.5	225	224.5	15.7	285	284.3	19.9
46	45.9	03.2	106	105.7	07.4	166	165.6	11.6	226	225.4	15.8	286	285.3	20.0
47	46.9	03.3	107	106.7	07.5	167	166.6	11.6	227	226.4	15.8	287	286.3	20.0
48	47.9	03.3	108	107.7	07.5	168	167.6	11.7	228	227.4	15.9	288	287.3	20.1
49	48.9	03.4	109	108.7	07.6	169	168.6	11.8	229	228.4	16.0	289	288.3	20.2
50	49.9	03.5	110	109.7	07.7	170	169.6	11.9	230	229.4	16.0	290	289.3	20.2
51	50.9	03.6	111	110.7	07.7	171	170.6	11.9	231	230.4	16.1	291	290.3	20.3
52	51.9	03.6	112	111.7	07.8	172	171.6	12.0	232	231.4	16.2	292	291.3	20.4
53	52.9	03.7	113	112.7	07.9	173	172.6	12.1	233	232.4	16.3	293	292.3	20.4
54	53.9	03.8	114	113.7	08.0	174	173.6	12.1	234	233.4	16.3	294	293.3	20.5
55	54.9	03.8	115	114.7	08.0	175	174.6	12.2	235	234.4	16.4	295	294.3	20.6
56	55.9	03.9	116	115.7	08.1	176	175.6	12.3	236	235.4	16.5	296	295.3	20.6
57	56.9	04.0	117	116.7	08.2	177	176.6	12.3	237	236.4	16.5	297	296.3	20.7
58	57.9	04.0	118	117.7	08.2	178	177.6	12.4	238	237.4	16.6	298	297.3	20.8
59	58.9	04.1	119	118.7	08.3	179	178.6	12.5	239	238.4	16.7	299	298.3	20.9
60	59.9	04·2	120	119.7	08.4	180	179.6	12.6	240	239.4	16.7	300	299.3	20.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 86 Degrees.

TABLE II.

Difference of Latitude and Departure for 5 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.8	05.3	121	120.5	10.5	181	180.3	15.8	241	240.1	21.0
2	02.0	00.2	62	61.8	05.4	122	121.5	10.6	182	181.3	15.9	242	241.1	21.1
3	03.0	00.3	63	62.8	05.5	123	122.5	10.7	183	182.3	15.9	243	242.1	21.2
4	04.0	00.3	64	63.8	05.6	124	123.5	10.8	184	183.3	16.0	244	243.1	21.3
5	05.0	00.4	65	64.8	05.7	125	124.5	10.9	185	184.3	16.1	245	244.1	21.4
6	06.0	00.5	66	65.7	05.8	126	125.5	11.0	186	185.3	16.2	246	245.1	21.4
7	07.0	00.6	67	66.7	05.8	127	126.5	11.1	187	186.3	16.3	247	246.1	21.5
8	08.0	00.7	68	67.7	05.9	128	127.5	11.2	188	187.3	16.4	248	247.1	21.6
9	09.0	00.8	69	68.7	06.0	129	128.5	11.2	189	188.3	16.5	249	248.1	21.7
10	10.0	00.9	70	69.7	06.1	130	129.5	11.3	190	189.3	16.6	250	249.0	21.7
11	11.0	01.0	71	70.7	06.2	131	130.5	11.4	191	190.3	16.6	251	250.0	21.9
12	12.0	01.0	72	71.7	06.3	132	131.5	11.5	192	191.3	16.7	252	251.0	22.0
13	13.0	01.1	73	72.7	06.4	133	132.5	11.6	193	192.3	16.8	253	252.0	22.1
14	13.9	01.2	74	73.7	06.4	134	133.5	11.7	194	193.3	16.9	254	253.0	22.1
15	14.9	01.3	75	74.7	06.5	135	134.5	11.8	195	194.3	17.0	255	254.0	22.2
16	15.9	01.4	76	75.7	06.6	136	135.5	11.9	196	195.3	17.1	256	255.0	22.3
17	16.9	01.5	77	76.7	06.7	137	136.5	11.9	197	196.3	17.2	257	256.0	22.4
18	17.9	01.6	78	77.7	06.8	138	137.5	12.0	198	197.2	17.3	258	257.0	22.5
19	18.9	01.7	79	78.7	06.9	139	138.5	12.1	199	198.2	17.3	259	258.0	22.6
20	19.9	01.7	80	79.7	07.0	140	139.5	12.2	200	199.2	17.4	260	259.0	22.7
21	20.9	01.8	81	80.7	07.1	141	140.5	12.3	201	200.2	17.5	261	260.0	22.7
22	21.9	01.9	82	81.7	07.1	142	141.5	12.4	202	201.2	17.6	262	261.0	22.8
23	22.9	02.0	83	82.7	07.2	143	142.5	12.5	203	202.2	17.7	263	262.0	22.9
24	23.9	02.1	84	83.7	07.3	144	143.5	12.6	204	203.2	17.8	264	263.0	23.0
25	24.9	02.2	85	84.7	07.4	145	144.4	12.6	205	204.2	17.9	265	264.0	23.1
26	25.9	02.3	86	85.7	07.5	146	145.4	12.7	206	205.2	18.0	266	265.0	23.2
27	26.9	02.4	87	86.7	07.6	147	146.4	12.8	207	206.2	18.0	267	266.0	23.3
28	27.9	02.4	88	87.7	07.7	148	147.4	12.9	208	207.2	18.1	268	267.0	23.4
29	28.9	02.5	89	88.7	07.8	149	148.4	13.0	209	208.2	18.2	269	268.0	23.4
30	29.9	02.6	90	89.7	07.8	150	149.4	13.1	210	209.2	18.3	270	269.0	23.5
31	30.9	02.7	91	90.7	07.9	151	150.4	13.2	211	210.2	18.4	271	270.0	23.6
32	31.9	02.8	92	91.6	08.0	152	151.4	13.2	212	211.2	18.5	272	271.0	23.7
33	32.9	02.9	93	92.6	08.1	153	152.4	13.3	213	212.2	18.6	273	272.0	23.8
34	33.9	03.0	94	93.6	08.2	154	153.4	13.4	214	213.2	18.7	274	273.0	23.9
35	34.9	03.1	95	94.6	08.3	155	154.4	13.5	215	214.2	18.7	275	274.0	24.0
36	35.9	03.1	96	95.6	08.4	156	155.4	13.6	216	215.2	18.8	276	274.9	24.1
37	36.9	03.2	97	96.6	08.5	157	156.4	13.7	217	216.2	18.9	277	275.9	24.1
38	37.9	03.3	98	97.6	08 5	158	157.4	13.8	218	217.2	19.0	278	276.9	24.2
39	38.9	03.4	99	98.6	08.6	159	158.4	13.9	219	218.2	19.1	279	277.9	24.3
40	39.8	03.5	100	99.6	08.7	160	159.4	13.9	220	219.2	19.2	280	278.9	24.4
41	40.8	03.6	101	100.6	08.8	161	160.4	14.0	221	220.2	19.3	281	279.9	24.5
42	41.8	03.7	102	101.6	08.9	162	161.4	14.1	222	221.2	19.3	282	280.9	24.6
43	42.8	03.7	103	102.6	09.0	163	162.4	14.2	223	222.2	19.4	283	281.9	24.7
44	43.8	03.8	104	103.6	09.1	164	163.4	14.3	224	223.1	19.5	284	282.9	24.8
45	44.8	03.9	105	104.6	09.2	165	164.4	14.4	225	224.1	19.6	285	283.9	24.8
46	45.8	04.0	106	105.6	09.2	166	165.4	14.5	226	225.1	19.7	286	284.9	24.9
47	46.8	04.1	107	106.6	09.3	167	166.4	14.6	227	226.1	19.8	287	285.9	25.0
48	47.8	04.2	108	107.6	09.4	168	167.4	14.6	228	227.1	19.9	288	286.9	25.1
49	48.8	04.3	109	108.6	09.5	169	168.4	14.7	229	228.1	20.0	289	287.9	25.2
50	49.8	04.4	110	109.6	09.6	170	169.4	14.8	230	229.1	20.0	290	288.9	25.3
51	50.8	04.4	111	110.6	09.7	171	170.3	14.9	231	230.1	20.1	291	289.9	25.4
52	51.8	04.5	112	111.6	09.8	172	171.3	15.0	232	231.1	20.2	292	290.9	25.4
53	52.8	04.6	113	112.6	09.8	173	172.3	15.1	233	232.1	20.3	293	291.9	25.5
54	53.8	04.7	114	113.6	09.9	174	173.3	15.2	234	233.1	20.4	294	292.9	25.6
55	54.8	04.8	115	114.6	10.0	175	174.3	15.3	235	234.1	20.5	295	293.9	25.7
56	55.8	04.9	116	115.6	10.1	176	175.3	15.3	236	235.1	20.6	296	294.9	25.8
57	56.8	05.0	117	116.6	10.2	177	176.3	15.4	237	236.1	20.7	297	295.9	25.9
58	57.8	05.1	118	117.6	10.3	178	177.3	15.5	238	237.1	20.7	298	296.9	26.0
59	58.8	05.1	119	118.5	10.4	179	178.3	15.6	239	238.1	20.8	299	297.9	26.1
60	59.8	05.2	120	119.5	10.5	180	179.3	15.7	240	239.1	20.9	300	298.9	26.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 85 Degrees.

TABLE II.

Difference of Latitude and Departure for 6 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep
1	01.0	00.1	61	60.7	06.4	121	120.3	12.6	181	180.0	18.9	241	239.7	25.2
2	02.0	00.2	62	61.7	06.5	122	121.3	12.8	182	181.0	19.0	242	240.7	25.3
3	03.0	00.3	63	62.7	06.6	123	122.3	12.9	183	182.0	19.1	243	241.7	25.4
4	04.0	00.4	64	63.6	06.7	124	123.3	13.0	184	183.0	19.2	244	242.7	25.5
5	05.0	00.5	65	64.6	06.8	125	124.3	13.1	185	184.0	19.3	245	243.7	25.6
6	06.0	00.6	66	65.6	06.9	126	125.3	13.2	186	185.0	19.4	246	244.7	25.7
7	07.0	00.7	67	66.6	07.0	127	126.3	13.3	187	186.0	19.5	247	245.6	25.8
8	08.0	00.8	68	67.6	07.1	128	127.3	13.4	188	187.0	19.7	248	246.6	25.9
9	09.0	00.9	69	68.6	07.2	129	128.3	13.5	189	188.0	19.8	249	247.6	26.0
10	09.9	01.0	70	69.6	07.3	130	129.3	13.6	190	189.0	19.9	250	248.6	26.1
11	10.9	01.1	71	70.6	07.4	131	130.3	13.7	191	190.0	20.0	251	249.6	26.2
12	11.9	01.3	72	71.6	07.5	132	131.3	13.8	192	190.9	20.1	252	250.6	26.3
13	12.9	01.4	73	72.6	07.6	133	132.3	13.9	193	191.9	20.2	253	251.6	26.4
14	13.9	01.5	74	73.6	07.7	134	133.3	14.0	194	192.9	20.3	254	252.6	26.6
15	14.9	01.6	75	74.6	07.8	135	134.3	14.1	195	193.9	20.4	255	253.6	26.7
16	15.9	01.7	76	75.6	07.9	136	135.3	14.2	196	194.9	20.5	256	254.6	26.8
17	16.9	01.8	77	76.6	08.0	137	136.2	14.3	197	195.9	20.6	257	255.6	26.9
18	17.9	01.9	78	77.6	08.2	138	137.2	14.4	198	196.9	20.7	258	256.6	27.0
19	18.9	02.0	79	78.6	08.3	139	138.2	14.5	199	197.9	20.8	259	257.6	27.1
20	19.9	02.1	80	79.6	08.4	140	139.2	14.6	200	198.9	20.9	260	258.6	27.2
21	20.9	02.2	81	80.6	08.5	141	140·2	14.7	201	199.9	21.0	261	259.6	27.3
22	21.9	02.3	82	81.6	08.6	142	141.2	14.8	202	200.9	21.1	262	260.6	27.4
23	22.9	02.4	83	82.5	08.7	143	142.2	14.9	203	201.9	21.2	263	261.6	27.5
24	23.9	02.5	84	83.5	08.8	144	143.2	15.1	204	202.9	21.3	264	262.6	27.6
25	24.9	02.6	85	84.5	08.9	145	144.2	15.2	205	203.9	21.4	265	263.5	27.7
26	25.9	02.7	86	85.5	09.0	146	145.2	15.3	206	204.9	21.5	266	264.5	27.8
27	26.9	02.8	87	86.5	09.1	147	146.2	15.4	207	205.9	21.6	267	265.5	27 9
28	27.8	02.9	88	87.5	09.2	148	147.2	15.5	208	206.9	21.7	268	266.5	28 0
29	28.8	03.0	89	88.5	09.3	149	148.2	15.6	209	207.9	21.8	269	267.5	28.1
30	29.8	03.1	90	89.5	09.4	150	149.2	15.7	210	208.8	22.0	270	268.5	28.2
31	30.8	03.2	91	90.5	09.5	151	150.2	15.8	211	209.8	22.1	271	269.5	28.3
32	31.8	03.3	92	91.5	09.6	152	151.2	15.9	212	210.8	22.2	272	270.5	28.4
33	32.8	03.4	93	92.5	09.7	153	152.2	16.0	213	211.8	22.3	273	271.5	28.5
34	33.8	03.6	94	93.5	09.8	154	153.2	16.1	214	212.8	22.4	274	272.5	28.6
35	34.8	03.7	95	94.5	09.9	155	154.2	16.2	215	213.8	22.5	275	273.5	28.7
36	35.8	03.8	96	95.5	10.0	156	155.1	16.3	216	214.8	22.6	276	274.5	28.8
37	36.8	03.9	97	96.5	10.1	157	156.1	16.4	217	215.8	22.7	277	275.5	29.0
38	37.8	04.0	98	97.5	10.2	158	157.1	16.5	218	216.8	22.8	278	276.5	29.1
39	38.8	04.1	99	98.5	10.3	159	158.1	16.6	219	217.8	22.9	279	277.5	29.2
40	39.8	04.2	100	99.5	10.5	160	159.1	16.7	220	218.8	23.0	280	278.5	29.3
41	40.8	04.3	101	100.4	10.6	161	160.1	16.8	221	219.8	23.1	281	279.5	29.4
42	41.8	04.4	102	101.4	10.7	162	161.1	16.9	222	220.8	23.2	282	280.5	29.5
43	42.8	04.5	103	102.4	10.8	163	162.1	17.0	223	221.8	23.3	283	281.4	29 6
44	43.8	04.6	104	103.4	10.9	164	163.1	17.1	224	222.8	23.4	284	282.4	29.7
45	44.8	04.7	105	104.4	11.0	165	164.1	17.2	225	223.8	23.5	285	283.4	29.8
46	45.7	04.8	106	105.4	11.1	166	165.1	17.4	226	224.8	23.6	286	284.4	29.9
47	46.7	04.9	107	106.4	11.2	167	166.1	17.5	227	225.8	23.7	287	285.4	30.0
48	47.7	05.0	108	107.4	11.3	168	167.1	17.6	228	226.8	23.8	288	286.4	30.1
49	48.7	05.1	109	108.4	11.4	169	168.1	17.7	229	227.7	23.9	289	287.4	30.2
50	49.7	05.2	110	109.4	11.5	170	169.1	17.8	230	228.7	24.0	290	288.4	30.3
51	50.7	05.3	111	110.4	11.6	171	170.1	17.9	231	229.7	24.1	291	289.4	30.4
52	51.7	05.4	112	111.4	11.7	172	171.1	18.0	232	230.7	24.3	292	290.4	30.5
53	52.7	05.5	113	112.4	11.8	173	172.1	18.1	233	231.7	24.4	293	291.4	30.6
54	53.7	05.6	114	113.4	11.9	174	173.0	18.2	234	232.7	24.5	294	292.4	30.7
55	54.7	05.7	115	114.4	12.0	175	174.0	18.3	235	233.7	24.6	295	293.4	30 8
56	55.7	05.9	116	115.4	12.1	176	175.0	18.4	236	234.7	24.7	296	294.4	30.9
57	56.7	06.0	117	116.4	12.2	177	176.0	18.5	237	235.7	24.8	297	295.4	31.0
58	57.7	06.1	118	117.4	12.3	178	177.0	18.6	238	236.7	24.9	298	296.4	31.1
59	58.7	06.2	119	118.3	12.4	179	178.0	18.7	239	237.7	25.0	299	297.4	31.3
60	59.7	06.3	120	119.3	12.5	180	179.0	18.8	240	238.7	25.1	300	298.4	31.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 84 Degrees.

TABLE II.

Difference of Latitude and Departure for 7 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.5	07.4	121	120.1	14.7	181	179.7	22.1	241	239.2	29.4
2	02.0	00.2	62	61.5	07.6	122	121.1	14.9	182	180.6	22.2	242	240.2	29.5
3	03.0	00.4	63	62.5	07.7	123	122.1	15.0	183	181.6	22.3	243	241.2	29.6
4	01.0	00.5	64	63.5	07.8	124	123.1	15.1	184	182.6	22.4	244	242.2	29.7
5	05.0	00.6	65	64.5	07.9	125	124.1	15.2	185	183.6	22.5	245	243.2	29.9
6	06.0	00.7	66	65.5	08.0	126	125.1	15.4	186	184.6	22.7	246	244.2	30.0
7	06.9	00.9	67	66.5	08.2	127	126.1	15.5	187	185.6	22.8	247	245.2	30.1
8	07.9	01.0	68	67.5	08.3	128	127.0	15.6	188	186.6	22.9	248	246.2	30.2
9	08.9	01.1	69	68.5	08.4	129	128.0	15.7	189	187.6	23.0	249	247.1	30.3
10	09.9	01.2	70	69.5	08.5	130	129.0	15.8	190	188.6	23.2	250	248.1	30.5
11	10.9	01.3	71	70.5	08.7	131	130.0	16.0	191	189.6	23.3	251	249.1	30.6
12	11.9	01.5	72	71.5	08.8	132	131.0	16.1	192	190.6	23.4	252	259.1	30.7
13	12.9	01.6	73	72.5	08.9	133	132.0	16.2	193	191.6	23.5	253	251.1	30.8
14	13.9	01.7	74	73.4	09.0	134	133.0	16.3	194	192.6	23.6	254	252.1	31.0
15	14.9	01.8	75	74.4	09.1	135	134.0	16.5	195	193.5	23.8	255	253.1	31.1
16	15.9	01.9	76	75.4	09.3	136	135.0	16.6	196	194.5	23.9	256	254.1	31.2
17	16.9	02.1	77	76.4	09.4	137	136.0	16.7	197	195.5	24.0	257	255.1	31.3
18	17.9	02.2	78	77.4	09.5	138	137.0	16.8	198	196.5	24.1	258	256.1	31.4
19	18.9	02.3	79	78.4	09.6	139	138.0	16.9	199	197.5	24.3	259	257.1	31.6
20	19.9	02.4	80	79.4	09.7	140	139.0	17.1	200	198.5	24.4	260	258.1	31.7
21	20.8	02.6	81	80.4	09.9	141	139.9	17.2	201	199.5	24.5	261	259.1	31.8
22	21.8	02.7	82	81.4	10.0	142	140.9	17.3	202	200.5	24.6	262	260.0	31.9
23	22.8	02.8	83	82.4	10.1	143	141.9	17.4	203	201.5	24.7	263	261.0	32.1
24	23.8	02.9	84	83.4	10.2	144	142.9	17.5	204	202.5	24.9	264	262.0	32.2
25	24.8	03.0	85	84.4	10.4	145	143.9	17.7	205	203.5	25.0	265	263.0	32.3
26	25.8	03.2	86	85.4	10.5	146	144.9	17.8	206	204.5	25.1	266	264.0	32.4
27	26.8	03.3	87	86.4	10.6	147	145.9	17.9	207	205.5	25.2	267	265.0	32.5
28	27.8	03.4	88	87.3	10.7	148	146.9	18.0	208	206.4	25.3	268	266.0	32.7
29	28.8	03.5	89	88.3	10.8	149	147.9	18.2	209	207.4	25.5	269	267.0	32.8
30	29.8	03.7	90	89.3	11.0	150	148.9	18.3	210	208.4	25.6	270	268.0	32.9
31	30.8	03.8	91	90.3	11.1	151	149.9	18.4	211	209.4	25.7	271	269.0	33.0
32	31.8	03.9	92	91.3	11.2	152	150.9	18.5	212	210.4	25.8	272	270.0	33.1
33	32.8	04.0	93	92.3	11.3	153	151.9	18.6	213	211.4	26.0	273	271.0	33.3
34	33.7	04.1	94	93.3	11.5	154	152.9	18.8	214	212.4	26.1	274	272.0	33.4
35	34.7	04.3	95	94.3	11.6	155	153.8	18.9	215	213.4	26.2	275	273.0	33.5
36	35.7	04.4	96	95.3	11.7	156	154.8	19.0	216	214.4	26.3	276	273.9	33.6
37	36.7	04.5	97	96.3	11.8	157	155.8	19.1	217	215.4	26.4	277	274.9	33.8
38	37.7	04.6	98	97.3	11.9	158	156.8	19.3	218	216.4	26.6	278	275.9	33.9
39	38.7	04.8	99	98.3	12.1	159	157.8	19.4	219	217.4	26.7	279	276.9	34.0
40	39.7	04.9	100	99.3	12.2	160	158.8	19.5	220	218.4	26.8	280	277.9	34.1
41	40.7	05.0	101	100.2	12.3	161	159.8	19.6	221	219.4	26.9	281	278.9	34.2
42	41.7	05.1	102	101.2	12.4	162	160.8	19.7	222	220.3	27.1	282	279.9	34.4
43	42.7	05.2	103	102.2	12.6	163	161.8	19.9	223	221.3	27.2	283	280.9	34.5
44	43.7	05.4	104	103.2	12.7	164	162.8	20.0	224	222.3	27.3	284	281.9	34.6
45	44.7	05.5	105	104.2	12.8	165	163.8	20.1	225	223.3	27.4	285	282.9	34.7
46	45.7	05.6	106	105.2	12.9	166	164.8	20.2	226	224.3	27.5	286	283.9	34.9
47	46.6	05.7	107	106.2	13.0	167	165.8	20.4	227	225.3	27.7	287	284.9	35.0
48	47.6	05.8	108	107.2	13.2	168	166.7	20.5	228	226.3	27.8	288	285.9	35.1
49	48.6	06.0	109	108.2	13.3	169	167.7	20.6	229	227.3	27.9	289	286.8	35.2
50	49.6	06.1	110	109.2	13.4	170	168.7	20.7	230	228.3	28.0	290	287.8	35.3
51	50.6	06.2	111	110.2	13.5	171	169.7	20.8	231	229.3	28.2	291	288.8	35.5
52	51.6	06.3	112	111.2	13.6	172	170.7	21.0	232	230.3	28.3	292	289.8	35.6
53	52.6	06.5	113	112.2	13.8	173	171.7	21.1	233	231.3	28.4	293	290.8	35.7
54	53.6	06.6	114	113.2	13.9	174	172.7	21.2	234	232.3	28.5	294	291.8	35.8
55	54.6	06.7	115	114.1	14.0	175	173.7	21.3	235	233.2	28.6	295	292.8	36.0
56	55.6	06.8	116	115.1	14.1	176	174.7	21.4	236	234.2	28.8	296	293.8	36.1
57	56.6	06.9	117	116.1	14.3	177	175.7	21.6	237	235.2	28.9	297	294.8	36.2
58	57.6	07.1	118	117.1	14.4	178	176.7	21.7	238	236.2	29.0	298	295.8	36.3
59	58.6	07.2	119	118.1	14.5	179	177.7	21.8	239	237.2	29.1	299	296.8	36.4
60	59.6	07.3	120	119.1	14.6	180	178.7	21.9	240	238.2	29.2	300	297.8	36.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 83 Degrees.

TABLE II.

Difference of Latitude and Departure for 8 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.1	61	60.4	08.5	121	119.8	16.8	181	179.2	25.2	241	238.7	33.5
2	02.0	00.3	62	61.4	08.6	122	120.8	17.0	182	180.2	25.3	242	239.6	33.7
3	03.0	00.4	63	62.4	08.8	123	121.8	17.1	183	181.2	25.5	243	240.6	33.8
4	04 0	00.6	64	63.4	08.9	124	122.8	17.3	184	182.2	25.6	244	241.6	34 0
5	05.0	00.7	65	64.4	09.0	125	123.8	17.4	185	183.2	25.7	245	242.6	34.1
6	05.9	00.8	66	65.4	09.2	126	124.8	17.5	186	184.2	25.9	246	243.6	34.2
7	06.9	01.0	67	66.3	09.3	127	125.8	17.7	187	185.2	26.0	247	244.6	34.4
8	07.9	01.1	68	67.3	09.5	128	126.8	17.8	188	186.2	26.2	248	245.6	34.5
9	08.9	01.3	69	68.3	09.6	129	127.7	18.0	189	187.2	26.3	249	246.6	34.7
10	09.9	01.4	70	69.3	09.7	130	128.7	18.1	190	188.2	26.4	250	247.6	34.8
11	10.9	01.5	71	70.3	09.9	131	129.7	18.2	191	189.1	26.6	251	248.6	34.9
12	11.9	01.7	72	71.3	10.0	132	130.7	18.4	192	190.1	26.7	252	249.5	35.1
13	12.9	01.8	73	72.3	10.2	133	131.7	18.5	193	191.1	26.9	253	250.5	35.2
14	13.9	01.9	74	73.3	10.3	134	132.7	18.6	194	192.1	27.0	254	251.5	35.3
15	14.8	02.1	75	74.3	10.4	135	133.7	18.8	195	193.1	27.1	255	252.5	35.5
16	15.8	02.2	76	75.3	10.6	136	134.7	18.9	196	194.1	27.3	256	253.5	35.6
17	16.8	02.4	77	76.3	10.7	137	135.7	19.1	197	195.1	27.4	257	254.5	35.8
18	17.8	02.5	78	77.2	10.9	138	136.7	19.2	198	196.1	27.6	258	255.5	35.9
19	18.8	02.6	79	78.2	11.0	139	137.7	19.3	199	197.1	27.7	259	256.5	36.0
20	19.8	02.8	80	79.2	11.1	140	138.6	19.5	200	198.1	27.8	260	257.5	36.2
21	20.8	02.9	81	80.2	11.3	141	139.6	19.6	201	199.0	28.0	261	258.5	36.3
22	21.8	03.1	82	81.2	11.4	142	140·6	19.8	202	200.0	28.1	262	259.5	36.5
23	22.8	03.2	83	82.2	11.6	143	141.6	19.9	203	201.0	28.3	263	260.4	36.6
24	23.8	03.3	84	83.2	11.7	144	142.6	20.0	204	202.0	28.4	264	261.4	36.7
25	24.8	03.5	85	84.2	11.8	145	143.6	20.2	205	203.0	28.5	265	262.4	36.9
26	25.7	03.6	86	85.2	12.0	146	144.6	20.3	206	204.0	28.7	266	263.4	37.0
27	26.7	03.8	87	86.2	12.1	147	145.6	20.5	207	205.0	28.8	267	264.4	37.2
28	27.7	03.9	88	87.1	12.2	148	146.6	20.6	208	206.0	28.9	268	265.4	37.3
29	28.7	04.0	89	88.1	12.4	149	147.5	20.7	209	207.0	29.1	269	266.4	37.4
30	29.7	04.2	90	89.1	12.5	150	148.5	20.9	210	208.0	29.2	270	267.4	37.6
31	30.7	04.3	91	90.1	12.7	151	149.5	21.0	211	208.9	29.4	271	268.4	37.7
32	31.7	04.5	92	91.1	12.8	152	150.5	21.2	212	209.9	29.5	272	269.4	37.9
33	32.7	04.6	93	92.1	12.9	153	151.5	21.3	213	210.9	29.6	273	270.3	38.0
34	33.7	04.7	94	93.1	13.1	154	152.5	21.4	214	211.9	29.8	274	271.3	38.1
35	34.7	04.9	95	94.1	13.2	155	153.5	21.6	215	212.9	29.9	275	272.3	38.3
36	35.6	05.0	96	95.1	13.4	156	154.5	21.7	216	213.9	30.1	276	273.3	38.4
37	36.6	05.1	97	96.1	13.5	157	155.5	21.9	217	214.9	30.2	277	274.3	38.6
38	37.6	05.3	98	97.0	13.6	158	156.5	22.0	218	215.9	30.3	278	275.3	38.7
39	38.6	05.4	99	98.0	13.8	159	157.5	22.1	219	216.9	30.5	279	276.3	38.8
40	39.6	05.6	100	99.0	13.9	160	158.4	22.3	220	217.9	30.6	280	277.3	39.0
41	40.6	05.7	101	100.0	14.1	161	159.4	22.4	221	218.8	30.8	281	278.3	39.1
42	41.6	05.8	102	101.0	14.2	162	160.4	22.5	222	219.8	30.9	282	279.3	39.2
43	42.6	06.0	103	102.0	14.3	163	161.4	22.7	223	220.8	31.0	283	280.2	39.4
44	43.6	06.1	104	103.0	14.5	164	162.4	22.8	224	221.8	31.2	284	281.2	39.5
45	44.6	06.3	105	104.0	14.6	165	163.4	23.0	225	222.8	31.3	285	282.2	39.7
46	45.6	06.4	106	105.0	14.8	166	164.4	23.1	226	223.8	31.5	286	283.2	39.8
47	46.5	06.5	107	106.0	14.9	167	165.4	23.2	227	224.8	31.6	287	284.2	39.9
48	47.5	06.7	108	106 9	15.0	168	166.4	23.4	228	225.8	31.7	288	285.2	40.1
49	48.5	06.8	109	107.9	15.2	169	167.4	23.5	229	226.8	31.9	289	286.2	40.2
50	49.5	07.0	110	108.9	15.3	170	168.3	23.7	230	227.8	32.0	290	287.2	40.4
51	56.5	07.1	111	109.9	15.4	171	169.3	23.8	231	228.8	32.1	291	288.2	40.5
52	51.5	07.2	112	110.9	15.6	172	170.3	23.9	232	229.7	32.3	292	289.2	40.6
53	52.5	07.4	113	111.9	15.7	173	171.3	24.1	233	230.7	32.4	293	290.1	40.8
54	53.5	07.5	114	112.9	15.9	174	172.3	24.2	234	231.7	32.6	294	291.1	40.9
55	54.5	07.7	115	113.9	16.0	175	173.3	24.4	235	232.7	32.7	295	292.1	41.1
56	55.5	07.8	116	114.9	16.1	176	174.3	24.5	236	233.7	32.8	296	293.1	41.2
57	56.4	07.9	117	115.9	16.3	177	175.3	24.6	237	234.7	33.0	297	294.1	41.3
58	57.4	08.1	118	116.9	16.4	178	176.3	24.8	238	235.7	33.1	298	295.1	41.5
59	58.4	08.2	119	117.8	16.6	179	177.3	24.9	239	236.7	33.3	299	296.1	41.6
60	59.4	08.4	120	118.8	16.7	180	178.2	25.1	240	237.7	33.4	300	297.1	41.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 82 Degrees.

TABLE II.

Difference of Latitude and Departure for 9 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	60.2	09.5	121	119.5	18.9	181	178.8	28.3	241	238.0	37.7
2	02.0	00.3	62	61.2	09.7	122	120.5	19.1	182	179.8	28.5	242	239.0	37.9
3	03.0	00.5	63	62.2	09.9	123	121.5	19.2	183	180.7	28.6	243	240.0	38.0
4	04.0	00.6	64	63.2	10.0	124	122.5	19.4	184	181.7	28.8	244	241.0	38.2
5	04.9	00.8	65	64.2	10.2	125	123.5	19.6	185	182.7	28.9	245	242.0	38.3
6	05.9	00.9	66	65.2	10.3	126	124.4	19.7	186	183.7	29.1	246	243.0	38.5
7	06.9	01.1	67	66.2	10.5	127	125.4	19.9	187	184.7	29.3	247	244.0	38.6
8	07.9	01.3	68	67.2	10.6	128	126.4	20.0	188	185.7	29.4	248	244.9	38.8
9	08.9	01.4	69	68.2	10.8	129	127.4	20.2	189	186.7	29.6	249	245.9	39.0
10	09.9	01.6	70	69.1	11.0	130	128.4	20.3	190	187 7	29.7	250	246.9	39.1
11	10.9	01.7	71	70.1	11.1	131	129.4	20.5	191	188.6	29.9	251	247.9	39.3
12	11.9	01.9	72	71.1	11.3	132	130.4	20.6	192	189.6	30.0	252	248.9	39.4
13	12.8	02.0	73	72.1	11.4	133	131.4	20.8	193	190.6	30.2	253	249.9	39.6
14	13.8	02.2	74	73.1	11.6	134	132.4	21.0	194	191.6	30.3	254	250.9	39.7
15	14.8	02.3	75	74.1	11.7	135	133.3	21.1	195	192.6	30.5	255	251.9	39.9
16	15.8	02.5	76	75.1	11.9	136	134.3	21.3	196	193.6	30.7	256	252.8	40.0
17	16.8	02.7	77	76.1	12.0	137	135.3	21.4	197	194.6	30.8	257	253.8	40.2
18	17.8	02.8	78	77.0	12.2	138	136.3	21.6	198	195.6	31.0	258	254.8	40.4
19	18.8	03.0	79	78.0	12.4	139	137.3	21.7	199	196.5	31.1	259	255.8	40.5
20	19.8	03.1	80	79.0	12.5	140	138.3	21.9	200	197.5	31.3	260	256.8	40.7
21	20.7	03.3	81	80.0	12.7	141	139.3	22.1	201	198.5	31.4	261	257.8	40.8
22	21.7	03.4	82	81.0	12.8	142	140.3	22.2	202	199.5	31.6	262	258.8	41.0
23	22.7	03.6	83	82.0	13.0	143	141.2	22.4	203	200.5	31.8	263	259.8	41.1
24	23.7	03.8	84	83.0	13.1	144	142.2	22.5	204	201.5	31.9	264	260.7	41.3
25	24.7	03.9	85	84.0	13.3	145	143.2	22.7	205	202.5	32.1	265	261.7	41.5
26	25.7	04.1	86	84.9	13.5	146	144.2	22.8	206	203.5	32.2	266	262.7	41.6
27	26 7	04.2	87	85.9	13.6	147	145.2	23.0	207	204.5	32.4	267	263.7	41.8
28	27.7	04.4	88	86.9	13.8	148	146.2	23.2	208	205.4	32.5	268	264.7	41.9
29	28.6	04·5	89	87.9	13.9	149	147.2	23.3	209	206.4	32.7	269	265.7	42.1
30	29.6	04.7	90	88.9	14.1	150	148.2	23.5	210	207.4	32.9	270	266.7	42.2
31	30.6	04.8	91	89.9	14.2	151	149.1	23.6	211	208.4	33.0	271	267.7	42.4
32	31.6	05.0	92	90.9	14.4	152	150.1	23.8	212	209.4	33.2	272	268.7	42.6
33	32.6	05.2	93	91.9	14.5	153	151.1	23.9	213	210.4	33.3	273	269.7	42.7
34	33.6	05.3	94	92.8	14.7	154	152.1	24.1	214	211.4	33.5	274	270.6	42.9
35	34.6	05.5	95	93.8	14.9	155	153.1	24.2	215	212.4	33.6	275	271.6	43.0
36	35.6	05.6	96	94.8	15.0	156	154.1	24.4	216	213.3	33.8	276	272.6	43.2
37	36.5	05.8	97	95.8	15.2	157	155.1	24.6	217	214.3	33.9	277	273.6	43.3
38	37.5	05.9	98	96.8	15.3	158	156.1	24.7	218	215.3	34.1	278	274.6	43.5
39	38.5	06.1	99	97.8	15.5	159	157.0	24.9	219	216.3	34.3	279	275.6	43.6
40	39.5	06.3	100	98.8	15.6	160	158.0	25.0	220	217.3	34.4	280	276.6	43.8
41	40.5	06.4	101	99.8	15.8	161	159.0	25.2	221	218.3	34.6	281	277.5	44.0
42	41.5	06.6	102	100.7	16.0	162	160.0	25.3	222	219.3	34.7	282	278.5	44.1
43	42.5	06.7	103	101.7	16.1	163	161.0	25.5	223	220.3	34.9	283	279.5	44.3
44	43.5	06.9	104	102.7	16.3	164	162.0	25.7	224	221.2	35.0	284	280.5	44.4
45	44.4	07.0	105	103.7	16.4	165	163.0	25.8	225	222.2	35.2	285	281.5	44.6
46	45.4	07.2	106	104.7	16.6	166	164.0	26.0	226	223.2	35.4	286	282.5	44.7
47	46.4	07.4	107	105.7	16.7	167	164.9	26.1	227	224.2	35.5	287	283.5	44.9
48	47.4	07.5	108	106.7	16.9	168	165.9	26.3	228	225.2	35.7	288	284.5	45.1
49	48.4	07.7	109	107.7	17.1	169	166.9	26.4	229	226.2	35.8	289	285.4	45.2
50	49.4	07.8	110	108.6	17.2	170	167.9	26.6	230	227.2	36.0	290	286.4	45.4
51	50.4	08.0	111	109.6	17.4	171	168.9	26.8	231	228.2	36.1	291	287.4	45.5
52	51.4	08.1	112	110.6	17.5	172	169.9	26.9	232	229.1	36.3	292	288.4	45.7
53	52.3	08.3	113	111.6	17.7	173	170.9	27.1	233	230.1	36.4	293	289.4	45.8
54	53.3	08.4	114	112.6	17.8	174	171.9	27.2	234	231.1	36.6	294	290.4	46.0
55	54.3	08.6	115	113.6	18.0	175	172.8	27.4	235	232.1	36.8	295	291.4	46.1
56	55.3	08.8	116	114.6	18.1	176	173.8	27.5	236	233.1	36.9	296	292.4	46.3
57	56.3	08.9	117	115.6	18.3	177	174.8	27.7	237	234.1	37.1	297	293.4	46.5
58	57.3	09.1	118	116.5	18.5	178	175.8	27.8	238	235.1	37.2	298	294.3	46.6
59	58.3	09.2	119	117.5	18.6	179	176.8	28.0	239	236.1	37.4	299	295.3	46.8
60	59.3	09.4	120	118.5	18.8	180	177.8	28.2	240	237.0	37.5	300	296.3	46.9
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 81 Degrees.

TABLE II.

Difference of Latitude and Departure for 10 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	60.1	10.6	121	119.2	21.0	181	178.3	31.4	241	237.3	41.8
2	02.0	00.3	62	61.1	10.8	122	120.1	21.2	182	179.2	31.6	242	238.3	42.0
3	03.0	00.5	63	62.0	10.9	123	121.1	21.4	183	180.2	31.8	243	239.3	42.2
4	03.9	00.7	64	63.0	11.1	124	122.1	21.5	184	181.2	32.0	244	240.3	42.4
5	04.9	00.9	65	64.0	11.3	125	123.1	21.7	185	182.2	32.1	245	241.3	42.5
6	05.9	01.0	66	65.0	11.5	126	124.1	21.9	186	183.2	32.3	246	242.3	42.7
7	06.9	01.2	67	66.0	11.6	127	125.1	22.1	187	184.2	32.5	247	243.2	42.9
8	07.9	01.4	68	67.0	11.8	128	126.1	22.2	188	185.1	32.6	248	244.2	43.1
9	08.9	01.6	69	68.0	12.0	129	127.0	22.4	189	186.1	32.8	249	245.2	43.2
10	09.8	01.7	70	68.9	12.2	130	128.0	22.6	190	187.1	33.0	250	246.2	43.4
11	10.8	01.9	71	69.9	12.3	131	129.0	22.7	191	188.1	33.2	251	247.2	43.6
12	11.8	02.1	72	70.9	12.5	132	130.0	22.9	192	189.1	33.3	252	248.2	43.8
13	12.8	02.3	73	71.9	12.7	133	131.0	23.1	193	190.1	33.5	253	249.2	43.9
14	13.8	02.4	74	72.9	12.8	134	132.0	23.3	194	191.0	33.7	254	250.1	44.1
15	14.8	02.6	75	73.9	13.0	135	132.9	23.4	195	192.0	33.9	255	251.1	44.3
16	15.8	02.8	76	74.8	13.2	136	133.9	23.6	196	193.0	34.0	256	252.1	44.5
17	16.7	03.0	77	75.8	13.4	137	134.9	23.8	197	194.0	34.2	257	253.1	44.6
18	17.7	03.1	78	76.8	13.5	138	135.9	24.0	198	195.0	34.4	258	254.1	44.8
19	18.7	03.3	79	77.8	13.7	139	136.9	24.1	199	196.0	34.6	259	255.1	45.0
20	19.7	03.5	80	78.8	13.9	140	137.9	24.3	200	197.0	34.7	260	256.1	45.1
21	20.7	03.6	81	79.8	14.1	141	138.9	24.5	201	197.9	34.9	261	257.0	45.3
22	21.7	03.8	82	80.8	14.2	142	139.8	24.7	202	198.9	35.1	262	258.0	45.5
23	22.7	04.0	83	81.7	14.4	143	140.8	24.8	203	199.9	35.3	263	259.0	45.7
24	23.6	04.2	84	82.7	14.6	144	141.8	25.0	204	200.9	35.4	264	260.0	45.8
25	24.6	04.3	85	83.7	14.8	145	142.8	25.2	205	201.9	35.6	265	261.0	46.0
26	25.6	04.5	86	84.7	14.9	146	143.8	25.4	206	202.9	35.8	266	262.0	46.2
27	26.6	04.7	87	85.7	15.1	147	144.8	25.5	207	203.9	35.9	267	262.9	46.4
28	27.6	04.9	88	86.7	15.3	148	145.8	25.7	208	204.8	36.1	268	263.9	46.5
29	28.6	05.0	89	87.6	15.5	149	146.7	25.9	209	205.8	36.3	269	264.9	46.7
30	29.5	05.2	90	88.6	15.6	150	147.7	26.0	210	206.8	36.5	270	265.9	46.9
31	30.5	05.4	91	89.6	15.8	151	148.7	26.2	211	207.8	36.6	271	266.9	47.1
32	31.5	05.6	92	90.6	16.0	152	149.7	26.4	212	208.8	36.8	272	267.9	47.2
33	32.5	05.7	93	91.6	16.1	153	150.7	26.6	213	209.8	37.0	273	268.9	47.4
34	33.5	05.9	94	92.6	16.3	154	151.7	26.7	214	210.7	37.2	274	269.8	47.6
35	34.5	06.1	95	93.6	16.5	155	152.6	26.9	215	211.7	37.3	275	270.8	47.8
36	35.5	06.3	96	94.5	16.7	156	153.6	27.1	216	212.7	37.5	276	271.8	47.9
37	36.4	06.4	97	95.5	16.8	157	154.6	27.3	217	213.7	37.7	277	272.8	48.1
38	37.4	06.6	98	96.5	17.0	158	155.6	27.4	218	214.7	37.9	278	273.8	48.3
39	38.4	06.8	99	97.5	17.2	159	156.6	27.6	219	215.7	38.0	279	274.8	48.4
40	39.4	06.9	100	98.5	17.4	160	157.6	27.8	220	216.7	38.2	280	275.7	48.6
41	40.4	07.1	101	99.5	17.5	161	158.6	28.0	221	217.6	38.4	281	276.7	48.8
42	41.4	07.3	102	100.5	17.7	162	159.5	28.1	222	218.6	38.5	282	277.7	49.0
43	42.3	07.5	103	101.4	17.9	163	160.5	28.3	223	219.6	38.7	283	278.7	49.1
44	43.3	07.6	104	102.4	18.1	164	161.5	28.5	224	220.6	38.9	284	279.7	49.3
45	44.3	07.8	105	103.4	18.2	165	162.5	28.7	225	221.6	39.1	285	280.7	49.5
46	45.3	08.0	106	104.4	18.4	166	163.5	28.8	226	222.6	39.2	286	281.7	49.7
47	46.3	08.2	107	105.4	18.6	167	164.5	29.0	227	223.6	39.4	287	282.6	49.8
48	47.3	08.3	108	106.4	18.8	168	165.4	29.2	228	224.5	39.6	288	283.6	50.0
49	48.3	08.5	109	107.3	18.9	169	166.4	29.3	229	225.5	39.8	289	284.6	50.2
50	49.2	08.7	110	108.3	19.1	170	167.4	29.5	230	226.5	39.9	290	285.6	50.4
51	50.2	08.9	111	109.3	19.3	171	168.4	29.7	231	227.5	40.1	291	286.6	50.5
52	51.2	09.0	112	110.3	19.4	172	169.4	29.9	232	228.5	40.3	292	287.6	50.7
53	52.2	09.2	113	111.3	19.6	173	170.4	30.0	233	229.5	40.5	293	288.5	50.9
54	53.2	09.4	114	112.3	19.8	174	171.4	30.2	234	230.4	40.6	294	289.5	51.1
55	54.2	09.6	115	113.3	20.0	175	172.3	30.4	235	231.4	40.8	295	290.5	51.2
56	55.1	09.7	116	114.2	20.1	176	173.3	30.6	236	232.4	41.0	296	291.5	51.4
57	56.1	09.9	117	115.2	20.3	177	174.3	30.7	237	233.4	41.2	297	292.5	51.6
58	57.1	10.1	118	116.2	20.5	178	175.3	30.9	238	234.4	41.3	298	293.5	51.7
59	58.1	10.2	119	117.2	20.7	179	176.3	31.1	239	235.4	41.5	299	294.5	51.9
60	59.1	10.4	120	118.2	20.8	180	177.3	31.3	240	236.4	41.7	300	295.4	52.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 80 Degrees.

TABLE II.

Difference of Latitude and Departure for 11 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.9	11.6	121	118.8	23.1	181	177.7	34.5	241	236.6	46.0
2	02.0	00.4	62	60.9	11.8	122	119.8	23.3	182	178.7	34.7	242	237.6	46.2
3	02.9	00.6	63	61.8	12.0	123	120.7	23.5	183	179.6	34.9	243	238.5	46.4
4	03.9	00.8	64	62.8	12.2	124	121.7	23.7	184	180.6	35.1	244	239.5	46.6
5	04.9	01.0	65	63.8	12.4	125	122.7	23.9	185	181.6	35.3	245	240.5	46.7
6	05.9	01.1	66	64.8	12.6	126	123.7	24.0	186	182.6	35.5	246	241.5	46.9
7	06.9	01.3	67	65.8	12.8	127	124.7	24.2	187	183.6	35.7	247	242.5	47.1
8	07.9	01.5	68	66.8	13.0	128	125.6	24.4	188	184.5	35.9	248	243.4	47.3
9	08.8	01.7	69	67.7	13.2	129	126.6	24.6	189	185.5	36.1	249	244.4	47.5
10	09.8	01.9	70	68.7	13.4	130	127.6	24.8	190	186.5	36.3	250	245.4	47.7
11	10.8	02.1	71	69.7	13.5	131	128.6	25.0	191	187.5	36.4	251	246.4	47.9
12	11.8	02.3	72	70.7	13.7	132	129.6	25.2	192	188.5	36.6	252	247.4	48.1
13	12.8	02.5	73	71.7	13.9	133	130.6	25.4	193	189.5	36.8	253	248.4	48.3
14	13.7	02.7	74	72.6	14.1	134	131.5	25.6	194	190.4	37.0	254	249.3	48.5
15	14.7	02.9	75	73.6	14.3	135	132.5	25.8	195	191.4	37.2	255	250.3	48.7
16	15.7	03.1	76	74.6	14.5	136	133.5	26.0	196	192.4	37.4	256	251.3	48.8
17	16.7	03.2	77	75.6	14.7	137	134.5	26.1	197	193.4	37.6	257	252.3	49.0
18	17.7	03.4	78	76.6	14.9	138	135.5	26.3	198	194.4	37.8	258	253.3	49.2
19	18.7	03.6	79	77.5	15.1	139	136.4	26.5	199	195.3	38.0	259	254.2	49.4
20	19.6	03.8	80	78.5	15.3	140	137.4	26.7	200	196.3	38.2	260	255.2	49.6
21	20.6	04.0	81	79.5	15.5	141	138.4	26.9	201	197.3	38.4	261	256.2	49.8
22	21.6	04.2	82	80.5	15.6	142	139.4	27.1	202	198.3	38.5	262	257.2	50.0
23	22.6	04.4	83	81.5	15.8	143	140.4	27.3	203	199.3	38.7	263	258.2	50.2
24	23.6	04.6	84	82.5	16.0	144	141.4	27.5	204	200.3	38.9	264	259.1	50.4
25	24.5	04.8	85	83.4	16.2	145	142.3	27.7	205	201.2	39.1	265	260.1	50.6
26	25.5	05.0	86	84.4	16.4	146	143.3	27.9	206	202.2	39.3	266	261.1	50.8
27	26.5	05.2	87	85.4	16.6	147	144.3	28.0	207	203.2	39.5	267	262.1	50.9
28	27.5	05.3	88	86.4	16.8	148	145.3	28.2	208	204.2	39.7	268	263.1	51.1
29	28.5	05.5	89	87.4	17.0	149	146.3	28.4	209	205.2	39.9	269	264.1	51.3
30	29.4	05.7	90	88.3	17.2	150	147.2	28.6	210	206.1	40.1	270	265.0	51.5
31	30.4	05.9	91	89.3	17.4	151	148.2	28.8	211	207.1	40.3	271	266.0	51.7
32	31.4	06.1	92	90.3	17.6	152	149.2	29.0	212	208.1	40.5	272	267.0	51.9
33	32.4	06.3	93	91.3	17.7	153	150.2	29.2	213	209.1	40.6	273	268.0	52.1
34	33.4	06.5	94	92.3	17.9	154	151.2	29.4	214	210.1	40.8	274	269.0	52.3
35	34.4	06.7	95	93.3	18.1	155	152.2	29.6	215	211.0	41.0	275	269.9	52.5
36	35.3	06.9	96	94.2	18.3	156	153.1	29.8	216	212.0	41.2	276	270.9	52.7
37	36.3	07.1	97	95.2	18.5	157	154.1	30.0	217	213.0	41.4	277	271.9	52.9
38	37.3	07.3	98	96.2	18.7	158	155.1	30.1	218	214.0	41.6	278	272.9	53.0
39	38.3	07.4	99	97.2	18.9	159	156.1	30.3	219	215.0	41.8	279	273.9	53.2
40	39.3	07.6	100	98.2	19.1	160	157.1	30.5	220	216.0	42.0	280	274.9	53.4
41	40.2	07.8	101	99.1	19.3	161	158.0	30.7	221	216.9	42.2	281	275.8	53.6
42	41.2	08.0	102	100.1	19.5	162	159.0	30.9	222	217.9	42.4	282	276.8	53.8
43	42.2	08.2	103	101.1	19.7	163	160.0	31.1	223	218.9	42.6	283	277.8	54.0
44	43.2	08.4	104	102.1	19.8	164	161.0	31.3	224	219.9	42.7	284	278.8	54.2
45	44.2	08.6	105	103.1	20.0	165	162.0	31.5	225	220.9	42.9	285	279.8	54.4
46	45.2	08.8	106	104.1	20.2	166	163.0	31.7	226	221.8	43.1	286	280.7	54.6
47	46.1	09.0	107	105.0	20.4	167	163.9	31.9	227	222.8	43.3	287	281.7	54.8
48	47.1	09.2	108	106.0	20.6	168	164.9	32.1	228	223.8	43.5	288	282.7	55.0
49	48.1	09.3	109	107.0	20.8	169	165.9	32.2	229	224.8	43.7	289	283.7	55.1
50	49.1	09.5	110	108.0	21.0	170	166.9	32.4	230	225.8	43.9	290	284.7	55.3
51	50.1	09.7	111	109.0	21.2	171	167.9	32.6	231	226.8	44.1	291	285.7	55.5
52	51.0	09.9	112	109.9	21.4	172	168.8	32.8	232	227.7	44.3	292	286.6	55.7
53	52.0	10.1	113	110.9	21.6	173	169.8	33.0	233	228.7	44.5	293	287.6	55.9
54	53.0	10.3	114	111.9	21.8	174	170.8	33.2	234	229.7	44.6	294	288.6	56.1
55	54.0	10.5	115	112.9	21.9	175	171.8	33.4	235	230.7	44.8	295	289.6	56.3
56	55.0	10.7	116	113.9	22.1	176	172.8	33.6	236	231.7	45.0	296	290.6	56.5
57	56.0	10.9	117	114.9	22.3	177	173.7	33.8	237	232.6	45.2	297	291.5	56.7
58	56.9	11.1	118	115.8	22.5	178	174.7	34.0	238	233.6	45.4	298	292.5	56.9
59	57.9	11.3	119	116.8	22.7	179	175.7	34.2	239	234.6	45.6	299	293.5	57.1
60	58.9	11.4	120	117.8	22.9	180	176.7	34.3	240	235.6	45.8	300	294.5	57.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 79 Degrees.

TABLE II.

Difference of Latitude and Departure for 12 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.7	12.7	121	118.4	25.2	181	177.0	37.6	241	235.7	50.1
2	02.0	00.4	62	60.6	12.9	122	119.3	25.4	182	178.0	37.8	242	236.7	50.3
3	02.9	00.6	63	61.6	13.1	123	120.3	25.6	183	179.0	38.0	243	237.7	50.5
4	03.9	00.8	64	62.6	13.3	124	121.3	25.8	184	180.0	38.3	244	238.7	50.7
5	04.9	01.0	65	63.6	13.5	125	122.3	26.0	185	181.0	38.5	245	239.6	50.9
6	05.9	01.2	66	64.6	13.7	126	123.2	26.2	186	181 9	38.7	246	240.6	51.1
7	06.8	01.5	67	65.5	13.9	127	124.2	26.4	187	182.9	38.9	247	241.6	51.4
8	07.8	01.7	68	66.5	14.1	128	125.2	26.6	188	183.9	39.1	248	242.6	51.6
9	08.8	01.9	69	67.5	14.3	129	126.2	26.8	189	184.9	39.3	249	243.6	51.8
10	09.8	02.1	70	68.5	14.6	130	127.2	27.0	190	185.8	39.5	250	244.5	52.0
11	10.8	02.3	71	69.4	14.8	131	128.1	27.2	191	186.8	39.7	251	245.5	52.2
12	11.7	02.5	72	70.4	15.0	132	129.1	27.4	192	187.8	39.9	252	246.5	52.4
13	12.7	02.7	73	71.4	15.2	133	130.1	27.7	193	188.8	40.1	253	247.5	52.6
14	13.7	02.9	74	72.4	15.4	134	131.1	27.9	194	189.8	40.3	254	248.4	52.8
15	14.7	03.1	75	73.4	15.6	135	132.0	28.1	195	190.7	40.5	255	249.4	53.0
16	15.7	03.3	76	74.3	15.8	136	133.0	28.3	196	191.7	40.8	256	250.4	53.2
17	16.6	03.5	77	75.3	16.0	137	134.0	28.5	197	192.7	41.0	257	251.4	53.4
18	17.6	03.7	78	76.3	16.2	138	135.0	28.7	198	193.7	41.2	258	252.4	53.6
19	18.6	04.0	79	77.3	16.4	139	136.0	28.9	199	194.7	41.4	259	253.3	53.8
20	19.6	04.2	80	78.3	16.6	140	136.9	29.1	200	195.6	41.6	260	254.3	54.1
21	20.5	04.4	81	79.2	16.8	141	137.9	29.3	201	196.6	41.8	261	255.3	54.3
22	21.5	04.6	82	80.2	17.0	142	138.9	29.5	202	197.6	42.0	262	256.3	54.5
23	22.5	04.8	83	81.2	17.3	143	139.9	29.7	203	198.6	42.2	263	257.3	54.7
24	23.5	05.0	84	82.2	17.5	144	140.9	29.9	204	199.5	42.4	264	258.2	54.9
25	24.5	05.2	85	83.1	17.7	145	141.8	30.1	205	200.5	42.6	265	259.2	55.1
26	25.4	05.4	86	84.1	17.9	146	142.8	30.4	206	201.5	42.8	266	260.2	55.3
27	26.4	05.6	87	85.1	18.1	147	143.8	30.6	207	202.5	43.0	267	261.2	55.5
28	27.4	05.8	88	86.1	18.3	148	144.8	30.8	208	203.5	43.2	268	262.1	55.7
29	28.4	06.0	89	87.1	18.5	149	145.7	31.0	209	204.4	43.5	269	263.1	55.9
30	29.3	06.2	90	88.0	18.7	150	146.7	31.2	210	205.4	43.7	270	264.1	56.1
31	30.3	06.4	91	89.0	18.9	151	147.7	31.4	211	206.4	43.9	271	265.1	56.3
32	31.3	06.7	92	90.0	19.1	152	148.7	31.6	212	207.4	44.1	272	266.1	56.6
33	32.3	06.9	93	91.0	19.3	153	149.7	31.8	213	208.3	44.3	273	267.0	56.8
34	33.3	07.1	94	91.9	19.5	154	150.6	32.0	214	209.3	44.5	274	268.0	57.0
35	34.2	07.3	95	92 9	19.8	155	151.6	32.2	215	210.3	44.7	275	269.0	57.2
36	35.2	07.5	96	93.9	20.0	156	152.6	32.4	216	211.3	44.9	276	270.0	57.4
37	36.2	07.7	97	94.9	20.2	157	153.6	32.6	217	212.3	45.1	277	270.9	57.6
38	37.2	07.9	98	95.9	20.4	158	154.5	32.9	218	213.2	45.3	278	271.9	57.8
39	38.1	08.1	99	96.8	20.6	159	155.5	33.1	219	214.2	45.5	279	272.9	58.0
40	39.1	08.3	100	97.8	20.8	160	156.5	33.3	220	215.2	45.7	280	273.9	58.2
41	40.1	08.5	101	98.8	21.0	161	157.5	33.5	221	216.2	45.9	281	274.9	58.4
42	41.1	08.7	102	99.8	21.2	162	158.5	33.7	222	217.1	46.2	282	275.8	58.6
43	42.1	08.9	103	100.7	21.4	163	159.4	33.9	223	218.1	46.4	283	276.8	58.8
44	43.0	09.1	104	101.7	21.6	164	160.4	34.1	224	219.1	46.6	284	277.8	59.0
45	44.0	09.4	105	102.7	21.8	165	161.4	34.3	225	220.1	46.8	285	278.8	59.3
46	45.0	09.6	106	103.7	22.0	166	162.4	34.5	226	221.1	47.0	286	279.8	59.5
47	46.0	09.8	107	104.7	22.2	167	163.4	34.7	227	222.0	47.2	287	280.7	59.7
48	47.0	10.0	108	105.6	22.5	168	164.3	34.9	228	223.0	47.4	288	281.7	59.9
49	47.9	10.2	109	106.6	22.7	169	165.3	35.1	229	224.0	47.6	289	282.7	60.1
50	48.9	10.4	110	107.6	22.9	170	166.3	35.3	230	225.0	47.8	290	283.7	60.3
51	49.9	10.6	111	108.6	23.1	171	167.3	35.6	231	226.0	48.0	291	284.6	60.5
52	50.9	10.8	112	109.6	23.3	172	168.2	35.8	232	226.9	48.2	292	285.6	60.7
53	51.8	11.0	113	110.5	23.5	173	169.2	36.0	233	227.9	48.4	293	286.6	60.9
54	52.8	11.2	114	111.5	23.7	174	170.2	36.2	234	228.9	48.7	294	287.6	61.1
55	53.8	11.4	115	112.5	23.9	175	171.2	36.4	235	229.9	48.9	295	288.6	61.3
56	54.8	11.6	116	113.5	24.1	176	172.2	36.6	236	230.8	49.1	296	289.5	61.5
57	55.8	11.9	117	114.4	24.3	177	173.1	36.8	237	231 .8	49.3	297	290.5	61.7
58	56.7	12.1	118	115.4	24.5	178	174.1	37.0	238	232.8	49.5	298	291.5	62.0
59	57.7	12.3	119	116.4	24.7	179	175.1	37.2	239	233.8	49.7	299	292.5	62.2
60	58.7	12.5	120	117.4	24.9	180	176.1	37.4	240	234.8	49.9	300	293.4	62.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 78 Degrees.

Difference of Latitude and Departure for 13 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.4	13.7	121	117.9	27.2	181	176.4	40.7	241	234.8	54.2
2	01.9	00.4	62	60.4	13.9	122	118.9	27.4	182	177.3	40.9	242	235.8	54.4
3	02.9	00.7	63	61.4	14.2	123	119.8	27.7	183	178.3	41.2	243	236.8	54.7
4	03.9	00.9	64	62.4	14.4	124	120.8	27.9	184	179.3	41.4	244	237.7	54.9
5	04.9	01.1	65	63.3	14.6	125	121.8	28.1	185	180.3	41.6	245	238.7	55.1
6	05.8	01.3	66	64.3	14.8	126	122.8	28.3	186	181.2	41.8	246	239.7	55.3
7	06.8	01.6	67	65.3	15.1	127	123.7	28.6	187	182.2	42.1	247	240.7	55.6
8	07.8	01.8	68	66.3	15.3	128	124.7	28.8	188	183.2	42.3	248	241.6	55.8
9	08.8	02.0	69	67.2	15.5	129	125.7	29.0	189	184.2	42.5	249	242.6	56.0
10	09.7	02.2	70	68.2	15.7	130	126.7	29.2	190	185.1	42.7	250	243.6	56.2
11	10.7	02.5	71	69.2	16.0	131	127.6	29.5	191	186.1	43.0	251	244.6	56.5
12	11.7	02.7	72	70.2	16.2	132	128.6	29.7	192	187.1	43.2	252	245.5	56.7
13	12.7	02.9	73	71.1	16.4	133	129.6	29.9	193	188.1	43.4	253	246.5	56.9
14	13.6	03.1	74	72.1	16.6	134	130.6	30.1	194	189.0	43.6	254	247.5	57.1
15	14.6	03.4	75	73.1	16.9	135	131.5	30.4	195	190.0	43.9	255	248.5	57.4
16	15.6	03.6	76	74.1	17.1	136	132.5	30.6	196	191.0	44.1	256	249.4	57.6
17	16.6	03.8	77	75.0	17.3	137	133.5	30.8	197	192.0	44.3	257	250.4	57.8
18	17.5	04.0	78	76.0	17.5	138	134.5	31.0	198	192.9	44.5	258	251.4	58.0
19	18.5	04.3	79	77.0	17.8	139	135.4	31.3	199	193.9	44.8	259	252.4	58.3
20	19.5	04.5	80	77.9	18.0	140	136.4	31.5	200	194.9	45.0	260	253.3	58.5
21	20.5	04.7	81	78.9	18.2	141	137.4	31.7	201	195.8	45.2	261	254.3	58.7
22	21.4	04.9	82	79.9	18.4	142	138.4	31.9	202	196.8	45.4	262	255.3	58.9
23	22.4	05.2	83	80.9	18.7	143	139.3	32.2	203	197.8	45.7	263	256.3	59.2
24	23.4	05.4	84	81.8	18.9	144	140.3	32.4	204	198.8	45.9	264	257.2	59.4
25	24.4	05.6	85	82.8	19.1	145	141.3	32.6	205	199.7	46.1	265	258.2	59.6
26	25.3	05.8	86	83.8	19.3	146	142.3	32.8	206	200.7	46.3	266	259.2	59.8
27	26.3	06.1	87	84.8	19.6	147	143.2	33.1	207	201.7	46.6	267	260.2	60.1
28	27.3	06.3	88	85.7	19.8	148	144.2	33.3	208	202.7	46.8	268	261.1	60.3
29	28.3	06.5	89	86.7	20.0	149	145.2	33.5	209	203.6	47.0	269	262.1	60.5
30	29.2	06.7	90	87.7	20.2	150	146.2	33.7	210	204.6	47.2	270	263.1	60.7
31	30.2	07.0	91	88.7	20.5	151	147.1	34.0	211	205.6	47.5	271	264.1	61.0
32	31.2	07.2	92	89.6	20.7	152	148.1	34.2	212	206.6	47.7	272	265.0	61.2
33	32.2	07.4	93	90.6	20.9	153	149.1	34.4	213	207.5	47.9	273	266.0	61.4
34	33.1	07.6	94	91.6	21.1	154	150.1	34.6	214	208.5	48.1	274	267.0	61.6
35	34.1	07.9	95	92.6	21.4	155	151.0	34.9	215	209.5	48.4	275	268.0	61.9
36	35.1	08.1	96	93.5	21.6	156	152.0	35.1	216	210.5	48.6	276	268.9	62.1
37	36.1	08.3	97	94.5	21.8	157	153.0	35.3	217	211.4	48.8	277	269.9	62.3
38	37.0	08.5	98	95.5	22.0	158	154.0	35.5	218	212.4	49.0	278	270.9	62.5
39	38.0	08.8	99	96.5	22.3	159	154.9	35.8	219	213.4	49.3	279	271.8	62.8
40	39.0	09.0	100	97.4	22.5	160	155.9	36.0	220	214.4	49.5	280	272.8	63.0
41	39.9	09.2	101	98.4	22.7	161	156.9	36.2	221	215.3	49.7	281	273.8	63.2
42	40.9	09.4	102	99.4	22.9	162	157.8	36.4	222	216.3	49.9	282	274.8	63.4
43	41.9	09.7	103	100.4	23.2	163	158.8	36.7	223	217.3	50.2	283	275.7	63.7
44	42.9	09.9	104	101.3	23.4	164	159.8	36.9	224	218.3	50.4	284	276.7	63.9
45	43.8	10.1	105	102.3	23.6	165	160.8	37.1	225	219.2	50.6	285	277.7	64.1
46	44.8	10.3	106	103.3	23.8	166	161.7	37.3	226	220.2	50.8	286	278.7	64.3
47	45.8	10.6	107	104.3	24.1	167	162.7	37.6	227	221.2	51.1	287	279.6	64.6
48	46.8	10.8	108	105.2	24.3	168	163.7	37.8	228	222.2	51.3	288	280.6	64.8
49	47.7	11.0	109	106.2	24.5	169	164.7	38.0	229	223.1	51.5	289	281.6	65.0
50	48.7	11.2	110	107.2	24.7	170	165.6	38.2	230	224.1	51.7	290	282.6	65.2
51	49.7	11.5	111	108.2	25.0	171	166.6	38.5	231	225.1	52.0	291	283.5	65.5
52	50.7	11.7	112	109.1	25.2	172	167.6	38.7	232	226.1	52.2	292	284.5	65.7
53	51.6	11.9	113	110.1	25.4	173	168.6	38.9	233	227.0	52.4	293	285.5	65.9
54	52.6	12.1	114	111.1	25.6	174	169.5	39.1	234	228.0	52.6	294	286.5	66.1
55	53.6	12.4	115	112.1	25.9	175	170.5	39.4	235	229.0	52.9	295	287.4	66.4
56	54.6	12.6	116	113.0	26.1	176	171.5	39.6	236	230.0	53.1	296	288.4	66.6
57	55.5	12.8	117	114.0	26.3	177	172.5	39.8	237	230.9	53.3	297	289.4	66.8
58	56.5	13.0	118	115.0	26.5	178	173.4	40.0	238	231.9	53.5	298	290.4	67.0
59	57.5	13.3	119	116.0	26.8	179	174.4	40.3	239	232.9	53.8	299	291.3	67.3
60	58.5	13.5	120	116.9	27.0	180	175.4	40.5	240	233.8	54.0	300	292.3	67.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 77 Degrees.

TABLE II.

Difference of Latitude and Departure for 14 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.2	61	59.2	14.8	121	117.4	29.3	181	175.6	43.8	241	233.8	58.3
2	01.9	00.5	62	60.2	15.0	122	118.4	29.5	182	176.6	44.0	242	234.8	58.5
3	02.9	00.7	63	61.1	15.2	123	119.3	29.8	183	177.6	44.3	243	235.8	58.8
4	03.9	01.0	64	62.1	15.5	124	120.3	30.0	184	178.5	44.5	244	236.8	59.0
5	04.9	01.2	65	63.1	15.7	125	121.3	30.2	185	179.5	44.8	245	237.7	59.3
6	05.8	01.5	66	64.0	16.0	126	122.3	30.5	186	180.5	45.0	246	238.7	59.5
7	06.8	01.7	67	65.0	16.2	127	123.2	30.7	187	181.4	45.2	247	239.7	59.8
8	07.8	01.9	68	66.0	16.5	128	124.2	31.0	188	182.4	45.5	248	240.6	60.0
9	08.7	02.2	69	67.0	16.7	129	125.2	31.2	189	183.4	45.7	249	241.6	60.2
10	09.7	02.4	70	67.9	16.9	130	126.1	31.4	190	184.4	46.0	250	242.6	60.5
11	10.7	02.7	71	68.9	17.2	131	127.1	31.7	191	185.3	46.2	251	243.5	60.7
12	11.6	02.9	72	69.9	17.4	132	128.1	31.9	192	186.3	46.4	252	244.5	61.0
13	12.6	03.1	73	70.8	17.7	133	129.0	32.2	193	187.3	46.7	253	245.5	61.2
14	13.6	03.4	74	71.8	17.9	134	130.0	32.4	194	188.2	46.9	254	246.5	61.4
15	14.6	03.6	75	72.8	18.1	135	131.0	32.7	195	189.2	47.2	255	247.4	61.7
16	15.5	03.9	76	73.7	18.4	136	132.0	32.9	196	190.2	47.4	256	248.4	61.9
17	16.5	04.1	77	74.7	18.6	137	132.9	33.1	197	191.1	47.7	257	249.4	62.2
18	17.5	04.4	78	75.7	18.9	138	133.9	33.4	198	192.1	47.9	258	250.3	62.4
19	18.4	04.6	79	76.7	19.1	139	134.9	33.6	199	193.1	48.1	259	251.3	62.7
20	19.4	04.8	80	77.6	19.4	140	135.8	33.9	200	194.1	48.4	260	252.3	62.9
21	20.4	05.1	81	78.6	19.6	141	136.8	34.1	201	195.0	48.6	261	253.2	63.1
22	21.3	05.3	82	79.6	19.8	142	137.8	34.4	202	196.0	48.9	262	254.2	63.4
23	22.3	05.6	83	80.5	20.1	143	138.8	34.6	203	197.0	49.1	263	255.2	63.6
24	23.3	05.8	84	81.5	20.3	144	139.7	34.8	204	197.9	49.4	264	256.2	63.9
25	24.3	06.0	85	82.5	20.6	145	140.7	35.1	205	198.9	49.6	265	257.1	64.1
26	25.2	06.3	86	83.4	20.8	146	141.7	35.3	206	199.9	49.8	266	258.1	64.4
27	26.2	06.5	87	84.4	21.0	147	142.6	35.6	207	200.9	50.1	267	259.1	64.6
28	27.2	06.8	88	85.4	21.3	148	143.6	35.8	208	201.8	50.3	268	260.0	64.8
29	28.1	07.0	89	86.4	21.5	149	144.6	36.0	209	202.8	50.6	269	261.0	65.1
30	29.1	07.3	90	87.3	21.8	150	145.5	36.3	210	203.8	50.8	270	262.0	65.3
31	30.1	07.5	91	88.3	22.0	151	146.5	36.5	211	204.7	51.0	271	263.0	65.6
32	31.0	07.7	92	89.3	22.3	152	147.5	36.8	212	205.7	51.3	272	263.9	65.8
33	32.0	08.0	93	90.2	22.5	153	148.5	37.0	213	206.7	51.5	273	264.9	66.0
34	33.0	08.2	94	91.2	22.7	154	149.4	37.3	214	207.6	51.8	274	265.9	66.3
35	34.0	08.5	95	92.2	23.0	155	150.4	37.5	215	208.6	52.0	275	266.8	66.5
36	34.9	08.7	96	93.1	23.2	156	151.4	37.7	216	209.6	52.3	276	267.8	66.8
37	35.9	09.0	97	94.1	23.5	157	152.3	38.0	217	210.6	52.5	277	268.8	67.0
38	36.9	09.2	98	95.1	23.7	158	153.3	38.2	218	211.5	52.7	278	269.7	67.3
39	37.8	09.4	99	96.1	24.0	159	154.3	38.5	219	212.5	53.0	279	270.7	67.5
40	38.8	09.7	100	97.0	24.2	160	155.2	38.7	220	213.5	53.2	280	271.7	67.7
41	39.8	09.9	101	98.0	24.4	161	156.2	38.9	221	214.4	53.5	281	272.7	68.0
42	40.8	10.2	102	99.0	24.7	162	157.2	39.2	222	215.4	53.7	282	273.6	68.2
43	41.7	10.4	103	99.9	24.9	163	158.2	39.4	223	216.4	53.9	283	274.6	68.5
44	42.7	10.6	104	100.9	25.2	164	159.1	39.7	224	217.3	54.2	284	275.6	68.7
45	43.7	10.9	105	101.9	25.4	165	160.1	39.9	225	218.3	54.4	285	276.5	68.9
46	44.6	11.1	106	102.9	25.6	166	161.1	40.2	226	219.3	54.7	286	277.5	69.2
47	45.6	11.4	107	103.8	25.9	167	162.0	40.4	227	220.3	54.9	287	278.5	69.4
48	46.6	11.6	108	104.8	26.1	168	163.0	40.6	228	221.2	55.2	288	279.4	69.7
49	47.5	11.9	109	105.8	26.4	169	164.0	40.9	229	222.2	55.4	289	280.4	69.9
50	48.5	12.1	110	106.7	26.6	170	165.0	41.1	230	223.2	55.6	290	281.4	70.2
51	49.5	12.3	111	107.7	26.9	171	165.9	41.4	231	224.1	55.9	291	282.4	70.4
52	50.5	12.6	112	108.7	27.1	172	166.9	41.6	232	225.1	56.1	292	283.3	70.6
53	51.4	12.8	113	109.6	27.3	173	167.9	41.9	233	226.1	56.4	293	284.3	70.9
54	52.4	13.1	114	110.6	27.6	174	168.8	42.1	234	227.0	56.6	294	285.3	71.1
55	53.4	13.3	115	111.6	27.8	175	169.8	42.3	235	228.0	56.9	295	286.2	71.4
56	54.3	13.5	116	112.6	28.1	176	170.8	42.6	236	229.0	57.1	296	287.2	71.6
57	55.3	13.8	117	113.5	28.3	177	171.7	42.8	237	230.0	57.3	297	288.2	71.9
58	56.3	14.0	118	114.5	28.6	178	172.7	43.1	238	230.9	57.6	298	289.1	72.1
59	57.2	14.3	119	115.5	28.8	179	173.7	43.3	239	231.9	57.8	299	290.1	72.3
60	58.2	14.5	120	116.4	29.0	180	174.7	43.5	240	232.9	58.1	300	291.1	72.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 76 Degrees.

TABLE II.

Difference of Latitude and Departure for 15 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.9	15.8	121	116.9	31.3	181	174.8	46.8	241	232.8	62.4
2	01.9	00.5	62	59.9	16.0	122	117.8	31.6	182	175.8	47.1	242	233.8	62.6
3	02.9	00.8	63	60.9	16.3	123	118.8	31.8	183	176.8	47.4	243	234.7	62.9
4	03.9	01.0	64	61.8	16.6	124	119.8	32.1	184	177.7	47.6	244	235.7	63.2
5	04.8	01.3	65	62.8	16.8	125	120.7	32.4	185	178.7	47.9	245	236.7	63.4
6	05.8	01.6	66	63.8	17.1	126	121.7	32.6	186	179.7	48.1	246	237.6	63.7
7	06.8	01.8	67	64.7	17.3	127	122.7	32.9	187	180.6	48.4	247	238.6	63.9
8	07.7	02.1	68	65.7	17.6	128	123.6	33.1	188	181.6	48.7	248	239.5	64.2
9	08.7	02.3	69	66.6	17.9	129	124.6	33.4	189	182.6	48.9	249	240.5	64.4
10	09.7	02.6	70	67.6	18.1	130	125.6	33.6	190	183.5	49.2	250	241.5	64.7
11	10.6	02.8	71	68.6	18.4	131	126.5	33.9	191	184.5	49.4	251	242.4	65.0
12	11.6	03.1	72	69.5	18.6	132	127.5	34.2	192	185.5	49.7	252	243.4	65.2
13	12.6	03.4	73	70.5	18.9	133	128.5	34.4	193	186.4	50.0	253	244.4	65.5
14	13.5	03.6	74	71.5	19.2	134	129.4	34.7	194	187.4	50.2	254	245.3	65.7
15	14.5	03.9	75	72.4	19.4	135	130.4	34.9	195	188.4	50.5	255	246.3	66.0
16	15.5	04.1	76	73.4	19.7	136	131.4	35.2	196	189.3	50.7	256	247.3	66.3
17	16.4	04.4	77	74.4	19.9	137	132.3	35.5	197	190.3	51.0	257	248.2	66.5
18	17.4	04.7	78	75.3	20.2	138	133.3	35.7	198	191.3	51.2	258	249.2	66.8
19	18.4	04.9	79	76.3	20.4	139	134.3	36.0	199	192.2	51.5	259	250.2	67.0
20	19.3	05.2	80	77.3	20.7	140	135.2	36.2	200	193.2	51.8	260	251.1	67.3
21	20.3	05.4	81	78.2	21.0	141	136.2	36.5	201	194.2	52.0	261	252.1	67.6
22	21.3	05.7	82	79.2	21.2	142	137.2	36.8	202	195.1	52.3	262	253.1	67.8
23	22.2	06.0	83	80.2	21.5	143	138.1	37.0	203	196.1	52.5	263	254.0	68.1
24	23.2	06.2	84	81.1	21.7	144	139.1	37.3	204	197.0	52.8	264	255.0	68.3
25	24.1	06.5	85	82.1	22.0	145	140.1	37.5	205	198.0	53.1	265	256.0	68.6
26	25.1	06.7	86	83.1	22.3	146	141.0	37.8	206	199.0	53.3	266	256.9	68.8
27	26.1	07.0	87	84.0	22.5	147	142.0	38.0	207	199.9	53.6	267	257.9	69.1
28	27.0	07.2	88	85.0	22.8	148	143.0	38.3	208	200.9	53.8	268	258.9	69.4
29	28.0	07.5	89	86.0	23.0	149	143.9	38.6	209	201.9	54.1	269	259.8	69.6
30	29.0	07.8	90	86.9	23.3	150	144.9	38.8	210	202.8	54.4	270	260.8	69.9
31	29.9	08.0	91	87.9	23.6	151	145.9	39.1	211	203.8	54.6	271	261.8	70.1
32	30.9	08.3	92	88.9	23.8	152	146.8	39.3	212	204.8	54.9	272	262.7	70.4
33	31.9	08.5	93	89.8	24.1	153	147.8	39.6	213	205.7	55.1	273	263.7	70.7
34	32.8	08.8	94	90.8	24.3	154	148.8	39.9	214	206.7	55.4	274	264.7	70.9
35	33.8	09.1	95	91.8	24.6	155	149.7	40.1	215	207.7	55.6	275	265.6	71.2
36	34.8	09.3	96	92.7	24.8	156	150.7	40.4	216	208.6	55.9	276	266.6	71.4
37	35.7	09.6	97	93.7	25.1	157	151.7	40.6	217	209.6	56.2	277	267.6	71.7
38	36.7	09.8	98	94.7	25.4	158	152.6	40.9	218	210.6	56.4	278	268.5	72.0
39	37.7	10.1	99	95.6	25.6	159	153.6	41.2	219	211.5	56.7	279	269.5	72.2
40	38.6	10.4	100	96.6	25.9	160	154.5	41.4	220	212.5	56.9	280	270.5	72.5
41	39.6	10.6	101	97.6	26.1	161	155.5	41.7	221	213.5	57.2	281	271.4	72.7
42	40.6	10.9	102	98.5	26.4	162	156.5	41.9	222	214.4	57.5	282	272.4	73.0
43	41.5	11.1	103	99.5	26.7	163	157.4	42.2	223	215.4	57.7	283	273.4	73.2
44	42.5	11.4	104	100.5	26.9	164	158.4	42.4	224	216.4	58.0	284	274.3	73.5
45	43.5	11.6	105	101.4	27.2	165	159.4	42.7	225	217.3	58.2	285	275.3	73.8
46	44.4	11.9	106	102.4	27.4	166	160.3	43.0	226	218.3	58.5	286	276.3	74.0
47	45.4	12.2	107	103.4	27.7	167	161.3	43.2	227	219.3	58.8	287	277.2	74.3
48	46.4	12.4	108	104.3	28.0	168	162.3	43.5	228	220.2	59.0	288	278.2	74.5
49	47.3	12.7	109	105.3	28.2	169	163.2	43.7	229	221.2	59.3	289	279.2	74.8
50	48.3	12.9	110	106.3	28.5	170	164.2	44.0	230	222.2	59.5	290	280.1	75.1
51	49.3	13.2	111	107.2	28.7	171	165.2	44.3	231	223.1	59.8	291	281.1	75.3
52	50.2	13.5	112	108.2	29.0	172	166.1	44.5	232	224.1	60.0	292	282.1	75.6
53	51.2	13.7	113	109.1	29.2	173	167.1	44.8	233	225.1	60.3	293	283.0	75.8
54	52.2	14.0	114	110.1	29.5	174	168.1	45.0	234	226.0	60.6	294	284.0	76.1
55	53.1	14.2	115	111.1	29.8	175	169.0	45.3	235	227.0	60.8	295	284.9	76.4
56	54.1	14.5	116	112.0	30.0	176	170.0	45.6	236	228.0	61.1	296	285.9	76.6
57	55.1	14.8	117	113.0	30.3	177	171.0	45.8	237	228.9	61.3	297	286.9	76.9
58	56.0	15.0	118	114.0	30.5	178	171.9	46.1	238	229.9	61.6	298	287.8	77.1
59	57.0	15.3	119	114.9	30.8	179	172.9	46.3	239	230.9	61.9	299	288.8	77.4
60	58.0	15.5	120	115.9	31.1	180	173.9	46.6	240	231.8	62.1	300	289.8	77.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 75 Degrees.

TABLE II.

Difference of Latitude and Departure for 16 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.6	16.8	121	116.3	33.4	181	174.0	49.9	241	231.7	66.4
2	01.9	00.6	62	59.6	17.1	122	117.3	33.6	182	174.9	50.2	242	232.6	66.7
3	02.9	00.8	63	60.6	17.4	123	118.2	33.9	183	175.9	50.4	243	233.6	67.0
4	03.8	01.1	64	61.5	17.6	124	119.2	34.2	184	176.9	50.7	244	234.5	67.3
5	04.8	01.4	65	62.5	17.9	125	120.2	34.5	185	177.8	51.0	245	235.5	67.5
6	05.8	01.7	66	63.4	18.2	126	121.1	34.7	186	178.8	51.3	246	236.5	67.8
7	06.7	01.9	67	64.4	18.5	127	122.1	35.0	187	179.8	51.5	247	237.4	68.1
8	07.7	02.2	68	65.4	18.7	128	123.0	35.3	188	180.7	51.8	248	238.4	68.4
9	08.7	02.5	69	66.3	19.0	129	124.0	35.6	189	181.7	52.1	249	239.4	68.6
10	09.6	02.8	70	67.3	19.3	130	125.0	35.8	190	182.6	52.4	250	240.3	68.9
11	10.6	03.0	71	68.2	19.6	131	125.9	36.1	191	183.6	52.6	251	241.3	69.2
12	11.5	03.3	72	69.2	19.8	132	126.9	36.4	192	184.6	52.9	252	242.2	69.5
13	12.5	03.6	73	70.2	20.1	133	127.8	36.7	193	185.5	53.2	253	243.2	69.7
14	13.5	03.9	74	71.1	20.4	134	128.8	36.9	194	186.5	53.5	254	244.2	70.0
15	14.4	04.1	75	72.1	20.7	135	129.8	37.2	195	187.4	53.7	255	245.1	70.3
16	15.4	04.4	76	73.1	20.9	136	130.7	37.5	196	188.4	54.0	256	246.1	70.6
17	16.3	04.7	77	74.0	21.2	137	131.7	37.8	197	189.4	54.3	257	247.0	70.8
18	17.3	05.0	78	75.0	21.5	138	132.7	38.0	198	190.3	54.6	258	248.0	71.1
19	18.3	05.2	79	75.9	21.8	139	133.6	38.3	199	191.3	54.9	259	249.0	71.4
20	19.2	05.5	80	76.9	22.1	140	134.6	38.6	200	192.3	55.1	260	249.9	71.7
21	20.2	05.8	81	77.9	22.3	141	135.5	38.9	201	193.2	55.4	261	250.9	71.9
22	21.1	06.1	82	78.8	22.6	142	136.5	39.1	202	194.2	55.7	262	251.9	72.2
23	22.1	06.3	83	79.8	22.9	143	137.5	39.4	203	195.1	56.0	263	252.8	72.5
24	23.1	06.6	84	80.7	23.2	144	138.4	39.7	204	196.1	56.2	264	253.8	72.8
25	24.0	06.9	85	81.7	23.4	145	139.4	40.0	205	197.1	56.5	265	254.7	73.0
26	25.0	07.2	86	82.7	23.7	146	140.3	40.2	206	198.0	56.8	266	255.7	73.3
27	26.0	07.4	87	83.6	24.0	147	141.3	40.5	207	199.0	57.1	267	256.7	73.6
28	26.9	07.7	88	84.6	24.3	148	142.3	40.8	208	199.9	57.3	268	257.6	73.9
29	27.9	08.0	89	85.6	24.5	149	143.2	41.1	209	200.9	57.6	269	258.6	74.1
30	28.8	08.3	90	86.5	24.8	150	144.2	41.3	210	201.9	57.9	270	259.5	74.4
31	29.8	08.5	91	87.5	25.1	151	145.2	41.6	211	202.8	58.2	271	260.5	74.7
32	30.8	08.8	92	88.4	25.4	152	146.1	41.9	212	203.8	58.4	272	261.5	75.0
33	31.7	09.1	93	89.4	25.6	153	147.1	42.2	213	204.7	58.7	273	262.4	75.2
34	32.7	09.4	94	90.4	25.9	154	148.0	42.4	214	205.7	59.0	274	263.4	75.5
35	33.6	09.6	95	91.3	26.2	155	149.0	42.7	215	206.7	59.3	275	264.3	75.8
36	34.6	09.9	96	92.3	26.5	156	150.0	43.0	216	207.6	59.5	276	265.3	76.1
37	35.6	10.2	97	93.2	26.7	157	150.9	43.3	217	208.6	59.8	277	266.3	76.4
38	36.5	10.5	98	94.2	27.0	158	151.9	43.6	218	209.6	60.1	278	267.2	76.6
39	37.5	10.7	99	95.2	27.3	159	152.8	43.8	219	210.5	60.4	279	268.2	76.9
40	38.5	11.0	100	96.1	27.6	160	153.8	44.1	220	211.5	60.6	280	269.2	77.2
41	39.4	11.3	101	97.1	27.8	161	154.8	44.4	221	212.4	60.9	281	270.1	77.5
42	40.4	11.6	102	98.0	28.1	162	155.7	44.7	222	213.4	61.2	282	271.1	77.7
43	41.3	11.9	103	99.0	28.4	163	156.7	44.9	223	214.4	61.5	283	272.0	78.0
44	42.3	12.1	104	100.0	28.7	164	157.6	45.2	224	215.3	61.7	284	273.0	78.3
45	43.3	12.4	105	100.9	28.9	165	158.6	45.5	225	216.3	62.0	285	274.0	78.6
46	44.2	12.7	106	101.9	29.2	166	159.6	45.8	226	217.2	62.3	286	274.9	78.8
47	45.2	13.0	107	102.9	29.5	167	160.5	46.0	227	218.2	62.6	287	275.9	79.1
48	46.1	13.2	108	103.8	29.8	168	161.5	46.3	228	219.2	62.8	288	276.8	79.4
49	47.1	13.5	109	104.8	30.0	169	162.5	46.6	229	220.1	63.1	289	277.8	79.7
50	48.1	13.8	110	105.7	30.3	170	163.4	46.9	230	221.1	63.4	290	278.8	79.9
51	49.0	14.1	111	106.7	30.6	171	164.4	47.1	231	222.1	63.7	291	279.7	80.2
52	50.0	14.3	112	107.7	30.9	172	165.3	47.4	232	223.0	63.9	292	280.7	80.5
53	50.9	14.6	113	108.6	31.1	173	166.3	47.7	233	224.0	64.2	293	281.6	80.8
54	51.9	14.9	114	109.6	31.4	174	167.3	48.0	234	224.9	64.5	294	282.6	81.0
55	52.9	15.2	115	110.5	31.7	175	168.2	48.2	235	225.9	64.8	295	283.6	81.3
56	53.8	15.4	116	111.5	32.0	176	169.2	48.5	236	226.9	65.1	296	284.5	81.6
57	54.8	15.7	117	112.5	32.2	177	170.1	48.8	237	227.8	65.3	297	285.5	81.9
58	55.8	16.0	118	113.4	32.5	178	171.1	49.1	238	228.8	65.6	298	286.5	82.1
59	56.7	16.3	119	114.4	32.8	179	172.1	49.3	239	229.7	65.9	299	287.4	82.4
60	57.7	16.5	120	115.4	33.1	180	173.0	49.6	240	230.7	66.2	300	288.4	82.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 74 Degrees.

TABLE II.

Difference of Latitude and Departure for 17 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.3	17.8	121	115.7	35.4	181	173.1	52.9	241	230.5	70.5
2	01.9	00.6	62	59.3	18.1	122	116.7	35.7	182	174.0	53.2	242	231.4	70.8
3	02.9	00.9	63	60.2	18.4	123	117.6	36.0	183	175.0	53.5	243	232.4	71.0
4	03.8	01.2	64	61.2	18.7	124	118.6	36.3	184	176.0	53.8	244	233.3	71.3
5	04.8	01.5	65	62.2	19.0	125	119.5	36.5	185	176.9	54.1	245	234.3	71.6
6	05.7	01.8	66	63.1	19.3	126	120.5	36.8	186	177.9	54.4	246	235.3	71.9
7	06.7	02.0	67	64.1	19.6	127	121.5	37.1	187	178.8	54.7	247	236.2	72.2
8	07.7	02.3	68	65.0	19.9	128	122.4	37.4	188	179.8	55.0	248	237.2	72.5
9	08.6	02.6	69	66.0	20.2	129	123.4	37.7	189	180.7	55.3	249	238.1	72.8
10	09.6	02.9	70	66.9	20.5	130	124.3	38.0	190	181.7	55.6	250	239.1	73.1
11	10.5	03.2	71	67.9	20.8	131	125.3	38.3	191	182.7	55.8	251	240.0	73.4
12	11.5	03.5	72	68.9	21.1	132	126.2	38.6	192	183.6	56.1	252	241.0	73.7
13	12.4	03.8	73	69.8	21.3	133	127.2	38.9	193	184.6	56.4	253	241.9	74.0
14	13.4	04.1	74	70.8	21.6	134	128.1	39.2	194	185.5	56.7	254	242.9	74.3
15	14.3	04.4	75	71.7	21.9	135	129.1	39.5	195	186.5	57.0	255	243.9	74.6
16	15.3	04.7	76	72.7	22.2	136	130.1	39.8	196	187.4	57.3	256	244.8	74.8
17	16.3	05.0	77	73.6	22.5	137	131.0	40.1	197	188.4	57.6	257	245.8	75.1
18	17.2	05.3	78	74.6	22.8	138	132.0	40.3	198	189.3	57.9	258	246.7	75.4
19	18.2	05.6	79	75.5	23.1	139	132.9	40.6	199	190.3	58.2	259	247.7	75.7
20	19.1	05.8	80	76.5	23.3	140	133.9	40.9	200	191.3	58.5	260	248.6	76.0
21	20.1	06.1	81	77.5	23.7	141	134.8	41.2	201	192.2	58.8	261	249.6	76.3
22	21.0	06.4	82	78.4	24.0	142	135.8	41.5	202	193.2	59.1	262	250.6	76.6
23	22.0	06.7	83	79.4	24.3	143	136.8	41.8	203	194.1	59.4	263	251.5	76.9
24	23.0	07.0	84	80.3	24.6	144	137.7	42.1	204	195.1	59.6	264	252.5	77.2
25	23.9	07.3	85	81.3	24.9	145	138.7	42.4	205	196.0	59.9	265	253.4	77.5
26	24.9	07.6	86	82.2	25.1	146	139.6	42.7	206	197.0	60.2	266	254.4	77.8
27	25.8	07.9	87	83.2	25.4	147	140.6	43.0	207	198.0	60.5	267	255.3	78.1
28	26.8	08.2	88	84.2	25.7	148	141.5	43.3	208	198.9	60.8	268	256.3	78.4
29	27.7	08.5	89	85.1	26.0	149	142.5	43.6	209	199.9	61.1	269	257.2	78.6
30	28.7	08.8	90	86.1	26.3	150	143.4	43.9	210	200.8	61.4	270	258.2	78.9
31	29.6	09.1	91	87.0	26.6	151	144.4	44.1	211	201.8	61.7	271	259.2	79.2
32	30.6	09.4	92	88.0	26.9	152	145.4	44.4	212	202.7	62.0	272	260.1	79.5
33	31.6	09.6	93	88.9	27.2	153	146.3	44.7	213	203.7	62.3	273	261.1	79.8
34	32.5	09.9	94	89.9	27.5	154	147.3	45.0	214	204.6	62.6	274	262.0	80.1
35	33.5	10.2	95	90.8	27.8	155	148.2	45.3	215	205.6	62.9	275	263.0	80.4
36	34.4	10.5	96	91.8	28.1	156	149.2	45.6	216	206.6	63.2	276	263.9	80.7
37	35.4	10.8	97	92.8	28.4	157	150.1	45.9	217	207.5	63.4	277	264.9	81.0
38	36.3	11.1	98	93.7	28.7	158	151.1	46.2	218	208.5	63.7	278	265.9	81.3
39	37.3	11.4	99	94.7	28.9	159	152.1	46.5	219	209.4	64.0	279	266.8	81.6
40	38.3	11.7	100	95.6	29.2	160	153.0	46.8	220	210.4	64.3	280	267.8	81.9
41	39.2	12.0	101	96.6	29.5	161	154.0	47.1	221	211.3	64.6	281	268.7	82.2
42	40.2	12.3	102	97.5	29.8	162	154.9	47.4	222	212.3	64.9	282	269.7	82.4
43	41.1	12.6	103	98.5	30.1	163	155.9	47.7	223	213.3	65.2	283	270.6	82.7
44	42.1	12.9	104	99.5	30.4	164	156.8	47.9	224	214.2	65.5	284	271.6	83.0
45	43.0	13.2	105	100.4	30.7	165	157.8	48.2	225	215.2	65.8	285	272.5	83.3
46	44.0	13.4	106	101.4	31.0	166	158.7	48.5	226	216.1	66.1	286	273.5	83.6
47	44.9	13.7	107	102.3	31.3	167	159.7	48.8	227	217.1	66.4	287	274.5	83.9
48	45.9	14.0	108	103.3	31.6	168	160.7	49.1	228	218.0	66.7	288	275.4	84.2
49	46.9	14.3	109	104.2	31.9	169	161.6	49.4	229	219.0	67.0	289	276.4	84.5
50	47.8	14.6	110	105.2	32.2	170	162.6	49.7	230	220.0	67.2	290	277.3	84.8
51	48.8	14.9	111	106.1	32.5	171	163.5	50.0	231	220.9	67.5	291	278.3	85.1
52	49.7	15.2	112	107.1	32.7	172	164.5	50.3	232	221.9	67.8	292	279.2	85.4
53	50.7	15.5	113	108.1	33.0	173	165.4	50.6	233	222.8	68.1	293	280.2	85.7
54	51.6	15.8	114	109.0	33.3	174	166.4	50.9	234	223.8	68.4	294	281.2	86.0
55	52.6	16.1	115	110.0	33.6	175	167.4	51.2	235	224.7	68.7	295	282.1	86.2
56	53.6	16.4	116	110.9	33.9	176	168.3	51.5	236	225.7	69.0	296	283.1	86.5
57	54.5	16.7	117	111.9	34.2	177	169.3	51.7	237	226.6	69.3	297	284.0	86.8
58	55.5	17.0	118	112.8	34.5	178	170.2	52.0	238	227.6	69.6	298	285.0	87.1
59	56.4	17.2	119	113.8	34.8	179	171.2	52.3	239	228.6	69.9	299	285.9	87.4
60	57.4	17.5	120	114.8	35.1	180	172.1	52.6	240	229.5	70.2	300	286.9	87.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 73 Degrees.

TABLE II.

Difference of Latitude and Departure for 18 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	01.0	00.3	61	58.0	18.9	121	115.1	37.4	181	172.1	55.9	241	229.2	74.5
2	01.9	00.6	62	59.0	19.2	122	116.0	37.7	182	173.1	56.2	242	230.2	74.8
3	02.9	00.9	63	59.9	19.5	123	117.0	38.0	183	174.0	56.6	243	231.1	75.1
4	03.8	01.2	64	60.9	19.8	124	117.9	38.3	184	175.0	56.9	244	232.1	75.4
5	04.8	01.5	65	61.8	20.1	125	118.9	38.6	185	175.9	57.2	245	233.0	75.7
6	05.7	01.9	66	62.8	20.4	126	119.8	38.9	186	176.9	57.5	246	234.0	76.0
7	06.7	02.2	67	63.7	20.7	127	120.8	39.2	187	177.8	57.8	247	234.9	76.3
8	07.6	02.5	68	64.7	21.0	128	121.7	39.6	188	178.8	58.1	248	235.9	76.6
9	08.6	02.8	69	65.6	21.3	129	122.7	39.9	189	179.7	58.4	249	236.8	76.9
10	09.5	03.1	70	66.6	21.6	130	123.6	40.2	190	180.7	58.7	250	237.8	77.3
11	10.5	03.4	71	67.5	21.9	131	124.6	40.5	191	181.7	59.0	251	238.7	77.6
12	11.4	03.7	72	68.5	22.2	132	125.5	40.8	192	182.6	59.3	252	239.7	77.9
13	12.4	04.0	73	69.4	22.6	133	126.5	41.1	193	183.6	59.6	253	240.6	78.2
14	13.3	04.3	74	70.4	22.9	134	127.4	41.4	194	184.5	59.9	254	241.6	78.5
15	14.3	04·6	75	71.3	23.2	135	128.4	41.7	195	185.5	60.3	255	242.5	78.8
16	15.2	04.9	76	72.3	23.5	136	129.3	42.0	196	186.4	60.6	256	243.5	79.1
17	16.2	05.3	77	73.2	23.8	137	130.3	42.3	197	187.4	60.9	257	244.4	79.4
18	17.1	05.6	78	74.2	24.1	138	131.2	42.6	198	188.3	61.2	258	245.4	79.7
19	18.1	05.9	79	75.1	24.4	139	132.2	43.0	199	189.3	61.5	259	246.3	80.0
20	19.0	06.2	80	76.1	24.7	140	133.1	43.3	200	190.2	61.8	260	247.3	80.3
21	20.0	06.5	81	77.0	25.0	141	134.1	43.6	201	191.2	62.1	261	248.2	80.7
22	20.9	06.8	82	78.0	25.3	142	135.1	43.9	202	192.1	62.4	262	249.2	81.0
23	21.9	07.1	83	78.9	25.6	143	136.0	44.2	203	193.1	62.7	263	250.1	81.3
24	22.8	07.4	84	79.9	26.0	144	137.0	44.5	204	194.0	63.0	264	251.1	81.6
25	23.8	07 7	85	80.8	26.3	145	137.9	44.8	205	195.0	63.3	265	252.0	81.9
26	24.7	08.0	86	81.8	26.6	146	138.9	45.1	206	195.9	63.7	266	253.0	82.2
27	25.7	08.3	87	82.7	26.9	147	139.8	45.4	207	196.9	64.0	267	253.9	82.5
28	26.6	08.7	88	83.7	27.2	148	140.8	45.7	208	197.8	64.3	268	254.9	82.8
29	27.6	09.0	89	84.6	27.5	149	141.7	46.0	209	198.8	64.6	269	255.8	83.1
30	28.5	09.3	90	85.6	27.8	150	142.7	46.4	210	199.7	64.9	270	256.8	83.4
31	29.5	09.6	91	86.5	28.1	151	143.6	46.7	211	200.7	65.2	271	257.7	83.7
32	30.4	09.9	92	87.5	28.4	152	144.6	47.0	212	201.6	65.5	272	258.7	84.1
33	31.4	10.2	93	88.4	28.7	153	145.5	47.3	213	202.6	65.8	273	259.6	84.4
34	32.3	10.5	94	89.4	29.0	154	146.5	47.6	214	203.5	66.1	274	260.6	84.7
35	33.3	10.8	95	90.4	29.4	155	147.4	47.9	215	204.5	66.4	275	261.5	85.0
36	34.2	11.1	96	91.3	29.7	156	148.4	48.2	216	205.4	66.7	276	262.5	85.3
37	35.2	11.4	97	92.3	30.0	157	149.3	48.5	217	206.4	67.1	277	263.4	85.6
38	36.1	11.7	98	93.2	30.3	158	150.3	48.8	218	207.3	67.4	278	264.4	85.9
39	37.1	12.1	99	94.2	30.6	159	151.2	49.1	219	208.3	67.7	279	265.3	86.2
40	38.0	12.4	100	95.1	30.9	160	152.2	49.4	220	209.2	68.0	280	266.3	86.5
41	39.0	12.7	101	96.1	31.2	161	153.1	49.8	221	210.2	68.3	281	267.2	86.8
42	39.9	13.0	102	97.0	31.5	162	154.1	50.1	222	211.1	68.6	282	268.2	87.1
43	40.9	13.3	103	98.0	31.8	163	155.0	50.4	223	212.1	68.9	283	269.1	87.5
44	41.8	13.6	104	98.9	32.1	164	156.0	50.7	224	213.0	69.2	284	270.1	87.8
45	42.8	13.9	105	99.9	32.4	165	156.9	51.0	225	214.0	69.5	285	271.1	88.1
46	43.7	14.2	106	100.8	32.8	166	157.9	51.3	226	214.9	69.8	286	272.0	88.4
47	44.7	14.5	107	101.8	33.1	167	158.8	51.6	227	215.9	70.1	287	273.0	88.7
48	45.7	14.8	108	102.7	33.4	168	159.8	51.9	228	216.8	70.5	288	273.9	89.0
49	46.6	15.1	109	103.7	33.7	169	160.7	52.2	229	217.8	70.8	289	274.9	89.3
50	47.6	15.5	110	104.6	34.0	170	161.7	52.5	230	218.7	71.1	290	275.8	89.6
51	48.5	15.8	111	105.6	34.3	171	162.6	52.8	231	219.7	71.4	291	276.8	89.9
52	49.5	16.1	112	106.5	34.6	172	163.6	53.2	232	220.6	71·7	292	277.7	90.2
53	50.4	16.4	113	107.5	34.9	173	164.5	53.5	233	221.6	72.0	293	278.7	90.5
54	51.4	16.7	114	108.4	35.2	174	165.5	53.8	234	222.5	72.3	294	279.6	90.9
55	52.3	17.0	115	109.4	35.5	175	166.4	54.1	235	223.5	72.6	295	280.6	91.2
56	53.3	17.3	116	110.3	35.8	176	167.4	54.4	236	224.4	72.9	296	281.5	91.5
57	54.2	17.6	117	111.3	36.2	177	168.3	54.7	237	225.4	73.2	297	282.5	91.8
58	55.2	17.9	118	112.2	36.5	178	169.3	55.0	238	226.4	73.5	298	283.4	92.1
59	56.1	18.2	119	113.2	36.8	179	170.2	55.3	239	227.3	73.9	299	284.4	92.4
60	57.1	18.5	120	114.1	37.1	180	171.2	55.6	240	228.3	74.2	300	285.3	92.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 72 Degrees.

TABLE II.

Difference of Latitude and Departure for 19 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.7	19.9	121	114.4	39.4	181	171.1	58.9	241	227.9	78.5
2	01.9	00.7	62	58.6	20.2	122	115.4	39.7	182	172.1	59.3	242	228.8	78.8
3	02.8	01.0	63	59.6	20.5	123	116.3	40.0	183	173.0	59.6	243	229.8	79.1
4	03.8	01.3	64	60.5	20.8	124	117.2	40.4	184	174.0	59.9	244	230.7	79.4
5	04.7	01.6	65	61.5	21.2	125	118.2	40.7	185	174.9	60.2	245	231.7	79.8
6	05.7	02.0	66	62.4	21.5	126	119.1	41.0	186	175.9	60.6	246	232.6	80.1
7	06.6	02.3	67	63.3	21 8	127	120.1	41.3	187	176.8	60.9	247	233.5	80.4
8	07.6	02.6	68	64.3	22.1	128	121.0	41.7	188	177.8	61.2	248	234.5	80.7
9	08.5	02.9	69	65.2	22.5	129	122.0	42.0	189	178.7	61.5	249	235.4	81.1
10	09.5	03.3	70	66.2	22.8	130	122.9	42.3	190	179.6	61.9	250	236.4	81.4
11	10.4	03.6	71	67.1	23.1	131	123.9	42.6	191	180.6	62.2	251	237.3	81.7
12	11.3	03.9	72	68.1	23.4	132	124.8	43.0	192	181.5	62.5	252	238.3	82.0
13	12.3	04.2	73	69.0	23.8	133	125.8	43.3	193	182.5	62.8	253	239.2	82.4
14	13.2	04.6	74	70.0	24.1	134	126.7	43.6	194	183.4	63.2	254	240.2	82.7
15	14.2	04.9	75	70.9	24.4	135	127.6	44.0	195	184.4	63.5	255	241.1	83.0
16	15.1	05.2	76	71.9	24.7	136	128.6	44.3	196	185.3	63.8	256	242.1	83.3
17	16.1	05.5	77	72.8	25.1	137	129.5	44.6	197	186.3	64.1	257	243.0	83.7
18	17.0	05.9	78	73.8	25.4	138	130.5	44.9	198	187.2	64.5	258	243.9	84.0
19	18.0	06.2	79	74.7	25.7	139	131.4	45.3	199	188.2	64.8	259	244.9	84.3
20	18.9	06.5	80	75.6	26.0	140	132.4	45.6	200	189.1	65.1	260	245.8	84.6
21	19.9	06.8	81	76.6	26.4	141	133.3	45.9	201	190.0	65.4	261	246.8	85.0
22	20.8	07.2	82	77.5	26.7	142	134.3	46.2	202	191.0	65.8	262	247.7	85.3
23	21.7	07.5	83	78.5	27.0	143	135.2	46.6	203	191.9	66.1	263	248.7	86.6
24	22.7	07.8	84	79.4	27.3	144	136.2	46.9	204	192.9	66.4	264	249.6	86 0
25	23.6	08.1	85	80.4	27.7	145	137.1	47.2	205	193.8	66.7	265	250.6	86.3
26	24.6	08.5	86	81.3	28.0	146	138.0	47.5	206	194.8	67.1	266	251.5	86.6
27	25.5	08.8	87	82.3	28.3	147	139.0	47.9	207	195.7	67.4	267	252.5	86.9
28	26.5	09.1	88	83.2	28.7	148	139.9	48.2	208	196.7	67.7	268	253.4	87.3
29	27.4	09.4	89	84.2	29.0	149	140.9	48.5	209	197.6	68.0	269	254.3	87.6
30	28.4	09.8	90	85.1	29.3	150	141.8	48.8	210	198.6	68.4	270	255.3	87.9
31	29.3	10.1	91	86.0	29.6	151	142.8	49.2	211	199.5	68.7	271	256.2	88.2
32	30.3	10.4	92	87.0	30.0	152	143.7	49.5	212	200.4	69.0	272	257.2	88.6
33	31.2	10.7	93	87.9	30.3	153	144.7	49.8	213	201.4	69.3	273	258.1	88.9
34	32.1	11.1	94	88.9	30.6	154	145.6	50.1	214	202.3	69.7	274	259.1	89.2
35	33.1	11.4	95	89.8	30.9	155	146.6	50.5	215	203.3	70.0	275	260.0	89.5
36	34.0	11.7	96	90.8	31.3	156	147.5	50.8	216	204.2	70.3	276	261.0	89.9
37	35.0	12.0	97	91.7	31.6	157	148.4	51.1	217	205.2	70.6	277	261.9	90.2
38	35.9	12.4	98	92.7	31.9	158	149.4	51.4	218	206.1	71.0	278	262.9	90.5
39	36.9	12.7	99	93.6	32.2	159	150.3	51.8	219	207.1	71.3	279	263.8	90.8
40	37.8	13.0	100	94.6	32.6	160	151.3	52.1	220	208.0	71.6	280	264.7	91.2
41	38.8	13.3	101	95.5	32.9	161	152.2	52.4	221	209.0	72.0	281	265.7	91.5
42	39.7	13.7	102	96.4	33.2	162	153.2	52.7	222	209.9	72.3	282	266.6	91.8
43	40.7	14.0	103	97.4	33.5	163	154.1	53.1	223	210.9	72.6	283	267.6	92.1
44	41.6	14.3	104	98.3	33.9	164	155.1	53.4	224	211.8	72.9	284	268.5	92.5
45	42.5	14.7	105	99.3	34.2	165	156.0	53.7	225	212.7	73.3	285	269.5	92.8
46	43.5	15.0	106	100.2	34.5	166	157.0	54.0	226	213.7	73.6	286	270.4	93.1
47	44.4	15.3	107	101.2	34.8	167	157.9	54.4	227	214.6	73.9	287	271.4	93.4
48	45.4	15.6	108	102.1	35.2	168	158.8	54.7	228	215.6	74.2	288	272.3	93.8
49	46.3	16.0	109	103.1	35.5	169	159.8	55.0	229	216.5	74.6	289	273.3	94.1
50	47.3	16.3	110	104.0	35.8	170	160.7	55.3	230	217.5	74.9	290	274.2	94.4
51	48.2	16.6	111	105.0	36.1	171	161.7	55.7	231	218.4	75.2	291	275.1	94.7
52	49.2	16.9	112	105.9	36.5	172	162.6	56.0	232	219.4	75.5	292	276.1	95.1
53	50.1	17.3	113	106.8	36.8	173	163.6	56.3	233	220.3	75.9	293	277.0	95.4
54	51.1	17.6	114	107.8	37.1	174	164.5	56.6	234	221.3	76.2	294	278.0	95.7
55	52.0	17.9	115	108.7	37.4	175	165.5	57.0	235	222.2	76.5	295	278.9	96.0
56	52.9	18.2	116	109.7	37.8	176	166.4	57.3	236	223.1	76.8	296	279.9	96.4
57	53.9	18.6	117	110.6	38.1	177	167.4	57.6	237	224.1	77.2	297	280.8	96.7
58	54.8	18.9	118	111.6	38.4	178	168.3	58.0	238	225.0	77.5	298	281.8	97.0
59	55.8	19.2	119	112.5	38.7	179	169.2	58.3	239	226.0	77.8	299	282.7	97.3
60	56.7	19.5	120	113.5	39.1	180	170.2	58.6	240	226.9	78.1	300	283.7	97.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 71 Degrees.

TABLE II.

Difference of Latitude and Departure for 20 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.3	61	57.3	20.9	121	113.7	41.4	181	170.1	61.9	241	226.5	82.4
2	01.9	00.7	62	58.3	21.2	122	114.6	41.7	182	171.0	62.2	242	227.4	82.8
3	02.8	01.0	63	59.2	21.5	123	115.6	42.1	183	172.0	62.6	243	228.3	83.1
4	03.8	01.4	64	60.1	21.9	124	116.5	42.4	184	172.9	62.9	244	229.3	83.5
5	04.7	01.7	65	61.1	22.2	125	117.5	42.8	185	173.8	63.3	245	230.2	83.8
6	05.6	02.1	66	62.0	22.6	126	118.4	43.1	186	174.8	63.6	246	231.2	84.2
7	06.6	02.4	67	63.0	22.9	127	119.3	43.4	187	175.7	64.0	247	232.1	84.5
8	07.5	02.7	68	63.9	23.3	128	120.3	43.8	188	176.7	64.3	248	233.0	84.8
9	08.5	03.1	69	64.8	23.6	129	121.2	44.1	189	177.6	64.6	249	234.0	85.2
10	09.4	03.4	70	65.8	23.9	130	122.2	44.5	190	178.5	65.0	250	234.9	85.5
11	10.3	03.8	71	66.7	24.3	131	123.1	44.8	191	179.5	65.3	251	235.9	85.8
12	11.3	04.1	72	67.7	24.6	132	124.0	45.1	192	180.4	65.7	252	236.8	86.2
13	12.2	04.4	73	68.6	25.0	133	125.0	45.5	193	181.4	66.0	253	237.7	86.5
14	13.2	04.8	74	69.5	25.3	134	125.9	45.8	194	182.3	66.4	254	238.7	86.9
15	14.1	05.1	75	70.5	25.7	135	126.9	46.2	195	183.2	66.7	255	239.6	87.2
16	15.0	05.5	76	71.4	26.0	136	127.8	46.5	196	184.[illegible]	67.0	256	240.6	87.6
17	16.0	05.8	77	72.4	26.3	137	128.7	46.9	197	185.1	67.4	257	241.5	87.9
18	16.9	06.2	78	73.3	26.7	138	129.7	47.2	198	186.1	67.7	258	242.4	88.2
19	17.9	06.5	79	74.2	27.0	139	130.6	47.5	199	187.0	68.1	259	243.4	88.6
20	18.8	06.8	80	75.2	27.4	140	131.6	47.9	200	187.9	68.4	260	244.3	88.9
21	19.7	07.2	81	76.1	27.7	141	132.5	48.2	201	188.9	68.7	261	245.3	89.3
22	20.7	07.5	82	77.1	28.0	142	133.4	48.6	202	189.8	69.1	262	246.2	89.6
23	21.6	07.9	83	78.0	28.4	143	134.4	48.9	203	190.8	69.4	263	247.[illegible]	90.0
24	22.6	08.2	84	78.9	28.7	144	135.3	49.3	204	191.7	69.8	264	248.1	90.3
25	23.5	08.6	85	79.9	29.1	145	136.3	49.6	205	192.6	70.1	265	249.0	90.6
26	24.4	08.9	86	80.8	29.4	146	137.2	49.9	206	193.6	70.5	266	250.0	91.0
27	25.4	09.2	87	81.8	29.8	147	138.1	50.3	207	194.5	70.8	267	250.9	91.3
28	26.3	09.6	88	82.7	30.1	148	139.1	50.6	208	195.5	71.1	268	251.8	91.7
29	27.3	09.9	89	83.6	30.4	149	140.0	51.0	209	196.4	71.5	269	252.8	92.0
30	28.2	10.3	90	84.6	30.8	150	141.0	51.3	210	197.3	71.8	270	253.7	92.3
31	29.1	10.6	91	85.5	31.1	151	141.9	51.6	211	198.3	72.2	271	254.7	92.7
32	30.1	10.9	92	86.5	31.5	152	142.8	52.0	212	199.2	72.5	272	255.6	93.0
33	31.0	11.3	93	87.4	31.8	153	143.8	52.3	213	200.2	72.9	273	256.5	93.4
34	31.9	11.6	94	88.3	32.1	154	144.7	52.7	214	201.1	73.2	274	257.5	93.7
35	32.9	12.0	95	89.3	32.5	155	145.7	53.0	215	202.0	73.5	275	258.4	94.1
36	33.8	12.3	96	90.2	32.8	156	146.6	53.4	216	203.0	73.9	276	259.4	94.4
37	34.8	12.7	97	91.2	33.2	157	147.5	53.7	217	203.9	74.2	277	260.3	94.7
38	35.7	13.0	98	92.1	33.5	158	148.5	54.0	218	204.9	74.6	278	261.2	95.1
39	36.6	13.3	99	93.0	33.9	159	149.4	54.4	219	205.8	74.9	279	262.2	95.4
40	37.6	13.7	100	94.0	34.2	160	150.4	54.7	220	206.7	75.2	280	263.1	95.8
41	38.5	14.0	101	94.9	34.5	161	151.3	55.1	221	207.7	75.6	281	264.1	96.1
42	39.5	14.4	102	95.8	34.9	162	152.2	55.4	222	208.6	75.9	282	265.0	96.4
43	40.4	14.7	103	96.8	35.2	163	153.2	55.7	223	209.6	76.3	283	265.9	96.8
44	41.3	15.0	104	97.7	35.6	164	154.1	56.1	224	210.5	76.6	284	266.9	97.1
45	42.3	15.4	105	98.7	35.9	165	155.0	56.4	225	211.4	77.0	285	267.8	97.5
46	43.2	15.7	106	99.6	36.3	166	156.0	56.8	226	212.4	77.3	286	268.8	97.8
47	44.2	16.1	107	100.5	36.6	167	156.9	57.1	227	213.3	77.6	287	269.7	98.2
48	45.1	16.4	108	101.5	36.9	168	157.9	57.5	228	214.2	78.0	288	270.6	98.5
49	46.0	16.8	109	102.4	37.3	169	158.8	57.8	229	215.2	78.3	289	271.6	98.8
50	47.0	17.1	110	103.4	37.6	170	159.7	58.1	230	216.1	78.7	290	272.5	99.2
51	47.9	17.4	111	104.3	38.0	171	160.7	58.5	231	217.1	79.0	291	273.5	99.5
52	48.9	17.8	112	105.2	38.3	172	161.6	58.8	232	218.0	79.3	292	274.4	99.9
53	49.8	18.1	113	106.2	38.6	173	162.6	59.2	233	218.9	79.7	293	275.3	100.2
54	50.7	18.5	114	107.1	39.0	174	163.5	59.5	234	219.9	80.0	294	276.3	100.6
55	51.7	18.8	115	108.1	39.3	175	164.4	59.9	235	220.8	80.4	295	277.2	100.9
56	52.6	19.2	116	109.0	39.7	176	165.4	60.2	236	221.8	80.7	296	278.1	101.2
57	53.6	19.5	117	109.9	40.0	177	166.3	60.5	237	222.7	81.1	297	279.1	101.6
58	54.5	19.8	118	110.9	40.4	178	167.3	60.9	238	223.6	81.4	298	280.0	101.9
59	55.4	20.2	119	111.8	40.7	179	168.2	61.2	239	224.6	81.7	299	281.0	102.3
60	56.4	20.5	120	112.8	41.0	180	169.1	61.6	240	225.5	82.1	300	281.9	102.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 70 Degrees.

TABLE II.

Difference of Latitude and Departure for 21 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.9	21.9	121	113.0	43.4	181	169.0	64.9	241	225.0	86.4
2	01.9	00.7	62	57.9	22.2	122	113.9	43.7	182	169.9	65.2	242	225.9	86.7
3	02.8	01.1	63	58.8	22.6	123	114.8	44.1	183	170.8	65.6	243	226.9	87.1
4	03.7	01.4	64	59.7	22.9	124	115.8	44.4	184	171.8	65.9	244	227.8	87.4
5	04.7	01.8	65	60.7	23.3	125	116.7	44.8	185	172.7	66.3	245	228.7	87.8
6	05.6	02.2	66	61.6	23.7	126	117.6	45.2	186	173.6	66.7	246	229.7	88.2
7	06.5	02.5	67	62.5	24.0	127	118.6	45.5	187	174.6	67.0	247	230.6	88.5
8	07.5	02.9	68	63.5	24.4	128	119.5	45.9	188	175.5	67.4	248	231.5	88.9
9	08.4	03.2	69	64.4	24.7	129	120.4	46.2	189	176.4	67.7	249	232.5	89.2
10	09.3	03.6	70	65.4	25.1	130	121.4	46.6	190	177.4	68.1	250	233.4	89.6
11	10.3	03.9	71	66.3	25.4	131	122.3	46.9	191	178.3	68.4	251	234.3	90.0
12	11.2	04.3	72	67.2	25.8	132	123.2	47.3	192	179.2	68.8	252	235.3	90.3
13	12.1	04.7	73	68.2	26.2	133	124.2	47.7	193	180.2	69.2	253	236.2	90.7
14	13.1	05.0	74	69.1	26.5	134	125.1	48.0	194	181.1	69.5	254	237.1	91.0
15	14.0	05.4	75	70.0	26.9	135	126.0	48.4	195	182.0	69.9	255	238.1	91.4
16	14.9	05.7	76	71.0	27.2	136	127.0	48.7	196	183.0	70.2	256	239.0	91.7
17	15.9	06.1	77	71.9	27.6	137	127.9	49.1	197	183.9	70.6	257	239.9	92.1
18	16.8	06.5	78	72.8	28.0	138	128.8	49.5	198	184.8	71.0	258	240.9	92.5
19	17.7	06.8	79	73.8	28.3	139	129.8	49.8	199	185.8	71.3	259	241.8	92.8
20	18.7	07.2	80	74.7	28.7	140	130.7	50.2	200	186.7	71.7	260	242.7	93.2
21	19.6	07 5	81	75.6	29.0	141	131.6	50.5	201	187.6	72.0	261	243.7	93.5
22	20.5	07.9	82	76.6	29.4	142	132.6	50.9	202	188.6	72.4	262	244.6	93.9
23	21.5	08.2	83	77.5	29.7	143	133.5	51.2	203	189.5	72.7	263	245.5	94.3
24	22.4	08.6	84	78.4	30.1	144	134.4	51.6	204	190.4	73.1	264	246.5	94.6
25	23.3	09.0	85	79.4	30.5	145	135.4	52.0	205	191.4	73.5	265	247.4	95.0
26	24.3	09.3	86	80.3	30.8	146	136.3	52.3	206	192.3	73.8	266	248.3	95.3
27	25.2	09.7	87	81.2	31.2	147	137.2	52.7	207	193.3	74.2	267	249.3	95.7
28	26.1	10.0	88	82.2	31.5	148	138.2	53.0	208	194.2	74.5	268	250.2	96.0
29	27.1	10.4	89	83.1	31.9	149	139.1	53.4	209	195.1	74.9	269	251.1	96.4
30	28.0	10.8	90	84.0	32.3	150	140.0	53.8	210	196.1	75.3	270	252.1	96.8
31	28.9	11.1	91	85.0	32.6	151	141.0	54.1	211	197.0	75.6	271	253.0	97.1
32	29.9	11.5	92	85.9	33.0	152	141.9	54.5	212	197.9	76.0	272	253.9	97.5
33	30.8	11.8	93	86.8	33.3	153	142.8	54.8	213	198.9	76.3	273	254.9	97.8
34	31.7	12.2	94	87.8	33.7	154	143.8	55.2	214	199.8	76.7	274	255.8	98.2
35	32.7	12.5	95	88.7	34.0	155	144.7	55.5	215	200.7	77.0	275	256.7	98.6
36	33.6	12.9	96	89.6	34.4	156	145.6	55.9	216	201.7	77.4	276	257.7	98.9
37	34.5	13.3	97	90.6	34.8	157	146.6	56.3	217	202.6	77.8	277	258.6	99.3
38	35.5	13.6	98	91.5	35.1	158	147.5	56.6	218	203.5	78.1	278	259.5	99.6
39	36.4	14.0	99	92.4	35.5	159	148.4	57.0	219	204.5	78.5	279	260.5	100.0
40	37.3	14.3	100	93.4	35.8	160	149.4	57.3	220	205.4	78.8	280	261.4	100.3
41	38.3	14.7	101	94.3	36.2	161	150.3	57.7	221	206.3	79.2	281	262.3	100.7
42	39.2	15.1	102	95.2	36.6	162	151.2	58.1	222	207.3	79.6	282	263.3	101.1
43	40.1	15.4	103	96.2	36.9	163	152.2	58.4	223	208.2	79.9	283	264.2	101.4
44	41.1	15.8	104	97.1	37.3	164	153.1	58.8	224	209.1	80.3	284	265.1	101.8
45	42.0	16.1	105	98.0	37.6	165	154.0	59.1	225	210.1	80.6	285	266.1	102.1
46	42.9	16.5	106	99.0	38.0	166	155.0	59.5	226	211.0	81.0	286	267.0	102.5
47	43.9	16.8	107	99.9	38.3	167	155.9	59.8	227	211.9	81.3	287	267.9	102.9
48	44.8	17.2	108	100.8	38.7	168	156.8	60.2	228	212.9	81.7	288	268.9	103.2
49	45.7	17.6	109	101.8	39.1	169	157.8	60.6	229	213.8	82.1	289	269.8	103.6
50	46.7	17.9	110	102.7	39.4	170	158.7	60.9	230	214.7	82.4	290	270.7	103.9
51	47.6	18.3	111	103.6	39.8	171	159.6	61.3	231	215.7	82.8	291	271.7	104.3
52	48.5	18.6	112	104.6	40.1	172	160.6	61.6	232	216.6	83.1	292	272.6	104.6
53	49.5	19.0	113	105.5	40.5	173	161.5	62.0	233	217.5	83.5	293	273.5	105.0
54	50.4	19.4	114	106.4	40.9	174	162.4	62.4	234	218.5	83.9	294	274.5	105.4
55	51.3	19.7	115	107.4	41.2	175	163.4	62.7	235	219.4	84.2	295	275.4	105.7
56	52.3	20.1	116	108.3	41.6	176	164.3	63.1	236	220.3	84.6	296	276.3	106.1
57	53.2	20.4	117	109.2	41.9	177	165.2	63.4	237	221.3	84.9	297	277.3	106.4
58	54.1	20.8	118	110.2	42.3	178	166.2	63.8	238	222.2	85.3	298	278.2	106.8
59	55.1	21.1	119	111.1	42.6	179	167.1	64.1	239	223.1	85.6	299	279.1	107.2
60	56.0	21.5	120	112.0	43.0	180	168.0	64.5	240	224.1	86.0	300	280.1	107.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 69 Degrees.

TABLE II.

Difference of Latitude and Departure for 22 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.6	22.9	121	112.2	45.3	181	167.8	67.8	241	223.5	90.3
2	01.9	00.7	62	57.5	23.2	122	113.1	45.7	182	168.7	68.2	242	224.4	90.7
3	02.8	01.1	63	58.4	23.6	123	114.0	46.1	183	169.7	68.6	243	225.3	91.0
4	03.7	01.5	64	59.3	24.0	124	115.0	46.5	184	170.6	68.9	244	226.2	91.4
5	04.6	01.9	65	60.3	24.3	125	115.9	46.8	185	171.5	69.3	245	227.2	91.8
6	05.6	02.2	66	61.2	24.7	126	116.8	47.2	186	172.5	69.7	246	228.1	92.2
7	06.5	02.6	67	62.1	25.1	127	117.8	47.6	187	173.4	70.1	247	229.0	92.5
8	07.4	03.0	68	63.0	25.5	128	118.7	47.9	188	174.3	70.4	248	229.9	92.9
9	08.3	03.4	69	64.0	25.8	129	119.6	48.3	189	175.2	70.8	249	230.9	93.3
10	09.3	03.7	70	64.9	26.2	130	120.5	48.7	190	176.2	71.2	250	231.8	93.7
11	10.2	04.1	71	65.8	26.6	131	121.5	49.1	191	177.1	71.5	251	232.7	94.0
12	11.1	04.5	72	66.8	27.0	132	122.4	49.4	192	178.0	71.9	252	233.7	94.4
13	12.1	04.9	73	67.7	27.3	133	123.3	49.8	193	178.9	72.3	253	234.6	94.8
14	13.0	05.2	74	68.6	27.7	134	124.2	50.2	194	179.9	72.7	254	235.5	95.2
15	13.9	05.6	75	69.5	28.1	135	125.2	50.6	195	180.8	73.0	255	236.4	95.5
16	14.8	06.0	76	70.5	28.5	136	126.1	50.9	196	181.7	73.4	256	237.4	95.9
17	15.8	06.4	77	71.4	28.8	137	127.0	51.3	197	182.7	73.8	257	238.3	96.3
18	16.7	06.7	78	72.3	29.2	138	128.0	51.7	198	183.6	74.2	258	239.2	96.6
19	17.6	07.1	79	73.2	29.6	139	128.9	52.1	199	184.5	74.5	259	240.1	97.0
20	18.5	07.5	80	74.2	30.0	140	129.8	52.4	200	185.4	74.9	260	241.1	97.4
21	19.5	07.9	81	75.1	30.3	141	130.7	52.8	201	186.4	75.3	261	242.0	97.8
22	20.4	08.2	82	76.0	30.7	142	131.7	53.2	202	187.3	75.7	262	242.9	98.1
23	21.3	08.6	83	77.0	31.1	143	132.6	53.6	203	188.2	76.0	263	243.8	98.5
24	22.3	09.0	84	77.9	31.5	144	133.5	53.9	204	189.1	76.4	264	244.8	98.9
25	23.2	09.4	85	78.8	31.8	145	134.4	54.3	205	190.1	76.8	265	245.7	99.3
26	24.1	09.7	86	79.7	32.2	146	135.4	54.7	206	191.0	77.2	266	246.6	99.6
27	25.0	10.1	87	80.7	32.6	147	136.3	55.1	207	191.9	77.5	267	247.6	100.0
28	26.0	10.5	88	81.6	33.0	148	137.2	55.4	208	192.9	77.9	268	248.5	100.4
29	26.9	10.9	89	82.5	33.3	149	138.2	55.8	209	193.8	78.3	269	249.4	100.8
30	27.8	11.2	90	83.4	33.7	150	139.1	56.2	210	194.7	78.7	270	250.3	101.1
31	28.7	11.6	91	84.4	34.1	151	140.0	56.6	211	195.6	79.0	271	251.3	101.5
32	29.7	12.0	92	85.3	34.5	152	140.9	56.9	212	196.6	79.4	272	252.2	101.9
33	30.6	12.4	93	86.2	34.8	153	141.9	57.3	213	197.5	79.8	273	253.1	102.3
34	31.5	12.7	94	87.2	35.2	154	142.8	57.7	214	198.4	80.2	274	254.0	102.6
35	32.5	13.1	95	88.1	35.6	155	143.7	58.1	215	199.3	80.5	275	255.0	103.0
36	33.4	13.5	96	89.0	36.0	156	144.6	58.4	216	200.3	80.9	276	255.9	103.4
37	34.3	13.9	97	89.9	36.3	157	145.6	58.8	217	201.2	81.3	277	256.8	103.8
38	35.2	14.2	98	90.9	36.7	158	146.5	59.2	218	202.1	81.7	278	257.8	104.1
39	36.2	14.6	99	91.8	37.1	159	147.4	59.6	219	203.1	82.0	279	258.7	104.5
40	37.1	15.0	100	92.7	37.5	160	148.3	59.9	220	204.0	82.4	280	259.6	104.9
41	38.0	15.4	101	93.6	37.8	161	149.3	60.3	221	201.9	82.8	281	260.5	105.3
42	38.9	15.7	102	94.6	38.2	162	150.2	60.7	222	205.8	83.2	282	261.5	105.6
43	39.9	16.1	103	95.5	38.6	163	151.1	61.1	223	206.8	83.5	283	262.4	106.0
44	40.8	16.5	104	96.4	39.0	164	152.1	61.4	224	207.7	83.9	284	263.3	106.4
45	41.7	16.9	105	97.4	39.3	165	153.0	61.8	225	208.6	84.3	285	264.2	106.8
46	42.7	17.2	106	98.3	39.7	166	153.9	62.2	226	209.5	84.7	286	265.2	107.1
47	43.6	17.6	107	99.2	40.1	167	154.8	62.6	227	210.5	85.0	287	266.1	107.5
48	44.5	18.0	108	100.1	40.5	168	155.8	62.9	228	211.4	85.4	288	267.0	107.9
49	45.4	18.4	109	101.1	40.8	169	156.7	63.3	229	212.3	85.8	289	268.0	108.3
50	46.4	18.7	110	102.0	41.2	170	157.6	63.7	230	213.3	86.2	290	268.9	108.6
51	47.3	19.1	111	102.9	41.6	171	158.5	64.1	231	214.2	86.5	291	269.8	109.0
52	48.2	19.5	112	103.8	42.0	172	159.5	64.4	232	215.1	86.9	292	270.7	109.4
53	49.1	19.9	113	104.8	42.3	173	160.4	64.8	233	216.0	87.3	293	271.7	109.8
54	50.1	20.2	114	105.7	42.7	174	161.3	65.2	234	217.0	87.7	294	272.6	110.1
55	51.0	20.6	115	106.6	43.1	175	162.3	65.6	235	217.9	88.0	295	273.5	110.5
56	51.9	21.0	116	107.6	43.5	176	163.2	65.9	236	218.8	88.4	296	274.4	110.9
57	52.8	21.4	117	108.5	43.8	177	164.1	66.3	237	219.7	88.8	297	275.4	111.3
58	53.8	21.7	118	109.4	44.2	178	165.0	66.7	238	220.7	89.2	298	276.3	111.6
59	54.7	22.1	119	110.3	44.6	179	166.0	67.1	239	221.6	89.5	299	277.2	112.0
60	55.6	22.5	120	111.3	45.0	180	166.9	67.4	240	222.5	89.9	300	278.2	112.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 68 Degrees.

TABLE II.

Difference of Latitude and Departure for 23 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	56.2	23.8	121	111.4	47.3	181	166.6	70.7	241	221.8	94.2
2	01.8	00.8	62	57.1	24.2	122	112.3	47.7	182	167.5	71.1	242	222.8	94.5
3	02.8	01.2	63	58.0	24.6	123	113.2	48.1	183	168.5	71.5	243	223.7	94.9
4	03.7	01.6	64	58.9	25.0	124	114.1	48.5	184	169.4	71.9	244	224.6	95.3
5	04.6	02.0	65	59.8	25.4	125	115.1	48.8	185	170.3	72.3	245	225.5	95.7
6	05.5	02.3	66	60.8	25.8	126	116.0	49.2	186	171.2	72.7	246	226.4	96.1
7	06.4	02.7	67	61.7	26.2	127	116.9	49.6	187	172.1	73.1	247	227.4	96.5
8	07.4	03.1	68	62.6	26.6	128	117.8	50.0	188	173.1	73.5	248	228 3	96.9
9	08.3	03.5	69	63.5	27.0	129	118.7	50.4	189	174.0	73.8	249	229.2	97.3
10	09.2	03.9	70	64.4	27.4	130	119.7	50.8	190	174.9	74.2	250	230.1	97.7
11	10.1	04.3	71	65.4	27.7	131	120.6	51.2	191	175.8	74.6	251	231.0	98.1
12	11.0	04.7	72	66.3	28.1	132	121.5	51.6	192	176.7	75.0	252	232.0	98.5
13	12.0	05.1	73	67.2	28.5	133	122.4	52.0	193	177.7	75.4	253	232.9	98.9
14	12.9	05.5	74	68.1	28.9	134	123.3	52.4	194	178 6	75.8	254	233.8	99.2
15	13.8	05.9	75	69.0	29.3	135	124.3	52.7	195	179.5	76.2	255	234.7	99.6
16	14.7	06.3	76	70.0	29.7	136	125.2	53.1	196	180.4	76.6	256	235.6	100.0
17	15.6	06.6	77	70.9	30.1	137	126.1	53.5	197	181.3	77.0	257	236.6	100.4
18	16.6	07.0	78	71.8	30.5	138	127.0	53.9	198	182.3	77.4	258	237.5	100.8
19	17.5	07.4	79	72.7	30.9	139	128.0	54.3	199	183.2	77.8	259	238.4	101.2
20	18.4	07.8	80	73.6	31.3	140	128.9	54.7	200	184.1	78.1	260	239.3	101.6
21	19.3	08.2	81	74.6	31.6	141	129.8	55.1	201	185.0	78.5	261	240.3	102.0
22	20.3	08.6	82	75.5	32.0	142	130.7	55.5	202	185.9	78.9	262	241.2	102.4
23	21.2	09.0	83	76.4	32.4	143	131.6	55.9	203	186.9	79.3	263	242.1	102.8
24	22.1	09.4	84	77.3	32.8	144	132.6	56.3	204	187.8	79.7	264	243.0	103.2
25	23.0	09.8	85	78.2	33.2	145	133.5	56.7	205	188.7	80.1	265	243.9	103.5
26	23.9	10.2	86	79.2	33.6	146	134.4	57.0	206	189.6	80.5	266	244.9	103.9
27	24.9	10.5	87	80.1	34.0	147	135.3	57.4	207	190.5	80.9	267	245.8	104.3
28	25.8	10.9	88	81.0	34.4	148	136.2	57.8	208	191.5	81.3	268	246.7	104.7
29	26.7	11.3	89	81.9	34.8	149	137 2	58.2	209	192.4	81.7	269	247.6	105.1
30	27.6	11.7	90	82.8	35.2	150	138.1	58.6	210	193.3	82.1	270	248.5	105.5
31	28.5	12.1	91	83.8	35.6	151	139.0	59.0	211	194.2	82.4	271	249.5	105.9
32	29.5	12.5	92	84.7	35.9	152	139.9	59.4	212	195.1	82.8	272	250.4	106.3
33	30.4	12.9	93	85.6	36.3	153	140.8	59.8	213	196.1	83.2	273	251.3	106.7
34	31.3	13.3	94	86.5	36.7	154	141.8	60.2	214	197.0	83.6	274	252.2	107.1
35	32.2	13.7	95	87.4	37.1	155	142.7	60.6	215	197.9	84.0	275	253.1	107.5
36	33.1	14.1	96	88.4	37.5	156	143.6	61.0	216	198.8	84.4	276	254.1	107.8
37	34.1	14.5	97	89.3	37.9	157	144.5	61.3	217	199.7	84.8	277	255.0	108.2
38	35.0	14.8	98	90.2	38.3	158	145.4	61.7	218	200.7	85.2	278	255.9	108.6
39	35.9	15.2	99	91.1	38.7	159	146.4	62.1	219	201.6	85.6	279	256.8	109.0
40	36.8	15.6	100	92.1	39.1	160	147.3	62.5	220	202.5	86.0	280	257.7	109.4
41	37.7	16.0	101	93.0	39.5	161	148.2	62.9	221	203.4	86.4	281	258.7	109.8
42	38.7	16.4	102	93.9	39.9	162	149.1	63.3	222	204.4	86.7	282	259.6	110.2
43	39.6	16.8	103	94.8	40.2	163	150.0	63.7	223	205.3	87.1	283	260.5	110.6
44	40.5	17.2	104	95.7	40.6	164	151.0	64.1	224	206.2	87.5	284	261.4	111.0
45	41.4	17.6	105	96.7	41.0	165	151.9	64.5	225	207.1	87.9	285	262.3	111.4
46	42.3	18.0	106	97.6	41.4	166	152.8	64.9	226	208.0	88.3	286	263.3	111.7
47	43.3	18.4	107	98.5	41.8	167	153.7	65.3	227	209.0	88.7	287	264.2	112.1
48	44.2	18.8	108	99.4	42.2	168	154.6	65.6	228	209.9	89.1	288	265.1	112.5
49	45.1	19.1	109	100 3	42.6	169	155.6	66.0	229	210.8	89.5	289	266.0	112.9
50	46.0	19.5	110	101.3	43.0	170	156.5	66.4	230	211.7	89.9	290	266.9	113.3
51	46.9	19.9	111	102.2	43.4	171	157.4	66.8	231	212.6	90.3	291	267.9	113.7
52	47.9	20.3	112	103.1	43.8	172	158.3	67.2	232	213.6	90.6	292	268.8	114.1
53	48.8	20.7	113	104.0	44.2	173	159.2	67.6	233	214.5	91.0	293	269.7	114.5
54	49.7	21.1	114	104.9	44.5	174	160.2	68.0	234	215.4	91.4	294	270.6	114.9
55	50.6	21.5	115	105.9	44.9	175	161.1	68.4	235	216.3	91.8	295	271.5	115.3
56	51.5	21.9	116	106.8	45.3	176	162.0	68.8	236	217.2	92.2	296	272.5	115.7
57	52.5	22.3	117	107.7	45.7	177	162.9	69.2	237	218.2	92.6	297	273.4	116.0
58	53.4	22.7	118	108.6	46.1	178	163.8	69.6	238	219.1	93.0	298	274.3	116.4
59	54.3	23.1	119	109.5	46.5	179	164.8	69.9	239	220.0	93.4	299	275.2	116.8
60	55.2	23.4	120	110.5	46.9	180	165.7	70.3	240	220.9	93.8	300	276.2	117.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 67 Degrees.

TABLE II.

Difference of Latitude and Departure for 24 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.7	24.8	121	110.5	49.2	181	165.4	73.6	241	220.2	98.0
2	01.8	00.8	62	56.6	25.2	122	111.5	49.6	182	166.3	74.0	242	221.1	98.4
3	02.7	01.2	63	57.6	25.6	123	112.4	50.0	183	167.2	74.4	243	222.0	98.8
4	03.7	01.6	64	58.5	26.0	124	113.3	50.4	184	168.1	74.8	244	222.9	99.2
5	04.6	02.0	65	59.4	26.4	125	114.2	50.8	185	169.0	75.2	245	223.8	99.7
6	05.5	02.4	66	60.3	26.8	126	115.1	51.2	186	169.9	75.7	246	224.7	100.1
7	06.4	02.8	67	61.2	27.3	127	116.0	51.7	187	170.8	76.1	247	225.6	100.5
8	07.3	03.3	68	62.1	27.7	128	116.9	52.1	188	171.7	76.5	248	226.6	100.9
9	08.2	03.7	69	63.0	28.1	129	117.8	52.5	189	172.7	76.9	249	227.5	101.3
10	09.1	04.1	70	63.9	28.5	130	118.8	52.9	190	173.6	77.3	250	228.4	101.7
11	10.0	04.5	71	64.9	28.9	131	119.7	53.3	191	174.5	77.7	251	229.3	102.1
12	11.0	04.9	72	65.8	29.3	132	120.6	53.7	192	175.4	78.1	252	230.2	102.5
13	11.9	05.3	73	66.7	29.7	133	121.5	54.1	193	176.3	78.5	253	231.1	102.9
14	12.8	05.7	74	67.6	30.1	134	122.4	54.5	194	177.2	78.9	254	232.0	103.3
15	13.7	06.1	75	68.5	30.5	135	123.3	54.9	195	178.1	79.3	255	233.0	103.7
16	14.6	06.5	76	69.4	30.9	136	124.2	55.3	196	179.1	79.7	256	233.9	104.1
17	15.5	06.9	77	70.3	31.3	137	125.2	55.7	197	180.0	80.1	257	234.8	104.5
18	16.4	07.3	78	71.3	31.7	138	126.1	56.1	198	180.9	80.5	258	235.7	104.9
19	17.4	07.7	79	72.2	32.1	139	127.0	56.5	199	181.8	80.9	259	236.6	105.3
20	18.3	08.1	80	73.1	32.5	140	127.9	56.9	200	182.7	81.3	260	237.5	105.8
21	19.2	08.5	81	74.0	32.9	141	128.8	57.3	201	183.6	81.8	261	238.4	106.2
22	20.1	08.9	82	74.9	33.4	142	129.7	57.8	202	184.5	82.2	262	239.3	106.6
23	21.0	09.4	83	75.8	33.8	143	130.6	58.2	203	185.4	82.6	263	240.3	107.0
24	21.9	09.8	84	76.7	34.2	144	131.6	58.6	204	186.4	83.0	264	241.2	107.4
25	22.8	10.2	85	77.7	34.6	145	132.5	59.0	205	187.3	83.4	265	242.1	107.8
26	23.8	10.6	86	78.6	35.0	146	133.4	59.4	206	188.2	83.8	266	243.0	108.2
27	24.7	11.0	87	79.5	35.4	147	134.3	59.8	207	189.1	84.2	267	243.9	108.6
28	25.6	11.4	88	80.4	35.8	148	135.2	60.2	208	190.0	84.6	268	244.8	109.0
29	26.5	11.8	89	81.3	36.2	149	136.1	60.6	209	190.9	85.0	269	245.7	109.4
30	27.4	12.2	90	82.2	36.6	150	137.0	61.0	210	191.8	85.4	270	246.7	109.8
31	28.3	12.6	91	83.1	37.0	151	137.9	61.4	211	192.8	85.8	271	247.6	110.2
32	29.2	13.0	92	84.0	37.4	152	138.9	61.8	212	193.7	86.2	272	248.5	110.6
33	30.1	13.4	93	85.0	37.8	153	139.8	62.2	213	194.6	86.6	273	249.4	111.0
34	31.1	13.8	94	85.9	38.2	154	140.7	62.6	214	195.5	87.0	274	250.3	111.4
35	32.0	14.2	95	86.8	38.6	155	141.6	63.0	215	196.4	87.4	275	251.2	111.9
36	32.9	14.6	96	87.7	39.0	156	142.5	63.5	216	197.3	87.9	276	252.1	112.3
37	33.8	15.0	97	88.6	39.5	157	143.4	63.9	217	198.2	88.3	277	253.1	112.7
38	34.7	15.5	98	89.5	39.9	158	144.3	64.3	218	199.2	88.7	278	254.0	113.1
39	35.6	15.9	99	90.4	40.3	159	145.3	64.7	219	200.1	89.1	279	254.9	113.5
40	36.5	16.3	100	91.4	40.7	160	146.2	65.1	220	201.0	89.5	280	255.8	113.9
41	37.5	16.7	101	92.3	41.1	161	147.1	65.5	221	201.9	89.9	281	256.7	114.3
42	38.4	17.1	102	93.2	41.5	162	148.0	65.9	222	202.8	90.3	282	257.6	114.7
43	39.3	17.5	103	94.1	41.9	163	148.9	66.3	223	203.7	90.7	283	258.5	115.1
44	40.2	17.9	104	95.0	42.3	164	149.8	66.7	224	204.6	91.1	284	259.4	115.5
45	41.1	18.3	105	95.9	42.7	165	150.7	67.1	225	205.5	91.5	285	260.4	115.9
46	42.0	18.7	106	96.8	43.1	166	151.6	67.5	226	206.5	91.9	286	261.3	116.3
47	42.9	19.1	107	97.7	43.5	167	152.6	67.9	227	207.4	92.3	287	262.2	116.7
48	43.9	19.5	108	98.7	43.9	168	153.5	68.3	228	208.3	92.7	288	263.1	117.1
49	44.8	19.9	109	99.6	44.3	169	154.4	68.7	229	209.2	93.1	289	264.0	117.5
50	45.7	20.3	110	100.5	44.7	170	155.3	69.1	230	210.1	93.5	290	264.9	118.0
51	46.6	20.7	111	101.4	45.1	171	156.2	69.6	231	211.0	94.0	291	265.8	118.4
52	47.5	21.2	112	102.3	45.6	172	157.1	70.0	232	211.9	94.4	292	266.8	118.8
53	48.4	21.6	113	103.2	46.0	173	158.0	70.4	233	212.9	94.8	293	267.7	119.2
54	49.3	22.0	114	104.1	46.4	174	159.0	70.8	234	213.8	95.2	294	268.6	119.6
55	50.2	22.4	115	105.1	46.8	175	159.9	71.2	235	214.7	95.6	295	269.5	120.0
56	51.2	22.8	116	106.0	47.2	176	160.8	71.6	236	215.6	96.0	296	270.4	120.4
57	52.1	23.2	117	106.9	47.6	177	161.7	72.0	237	216.5	96.4	297	271.3	120.8
58	53.0	23.6	118	107.8	48.0	178	162.6	72.4	238	217.4	96.8	298	272.2	121.2
59	53.9	24.0	119	108.7	48.4	179	163.5	72.8	239	218.3	97.2	299	273.2	121.6
60	54.8	24.4	120	109.6	48.8	180	164.4	73.2	240	219.3	97.6	300	274.1	122.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 66 Degrees.

TABLE II.

Difference of Latitude and Departure for 25 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	55.3	25.8	121	109.7	51.1	181	164.0	76.5	241	218.4	101.9
2	01.8	00.8	62	56.2	26.2	122	110.6	51.6	182	164.9	76.9	242	219.3	102.3
3	02.7	01.3	63	57.1	26.6	123	111.5	52.0	183	165.9	77.3	243	220.2	102.7
4	03.6	01.7	64	58.0	27.0	124	112.4	52.4	184	166.8	77.8	244	221.1	103.1
5	04.5	02.1	65	58.9	27.5	125	113.3	52.8	185	167.7	78.2	245	222.0	103.5
6	05.4	02.5	66	59.8	27.9	126	114.2	53.2	186	168.6	78.6	246	223.0	104.0
7	06.3	03.0	67	60.7	28.3	127	115.1	53.7	187	169.5	79.0	247	223.9	104.4
8	07.3	03.4	68	61.6	28.7	128	116.0	54.1	188	170.4	79.5	248	224.8	104.8
9	08.2	03.8	69	62.5	29.2	129	116.9	54.5	189	171.3	79.9	249	225.7	105.2
10	09.1	04.2	70	63.4	29.6	130	117.8	54.9	190	172.2	80.3	250	226.6	105.7
11	10.0	04.6	71	64.3	30.0	131	118.7	55.4	191	173.1	80.7	251	227.5	106.1
12	10.9	05.1	72	65.3	30.4	132	119.6	55.8	192	174.0	81.1	252	228.4	106.5
13	11.8	05.5	73	66.2	30.9	133	120.5	56.2	193	174.9	81.6	253	229.3	106.9
14	12.7	05.9	74	67.1	31.3	134	121.4	56.6	194	175.8	82.0	254	230.2	107.3
15	13.6	06.3	75	68.0	31.7	135	122.4	57.1	195	176.7	82.4	255	231.1	107.8
16	14.5	06.8	76	68.9	32.1	136	123.3	57.5	196	177.6	82.8	256	232.0	108.2
17	15.4	07.2	77	69.8	32.5	137	124.2	57.9	197	178.5	83.3	257	232.9	108.6
18	16.3	07.6	78	70.7	33.0	138	125.1	58.3	198	179.4	83.7	258	233.8	109.0
19	17.2	08.0	79	71.6	33.4	139	126.0	58.7	199	180.4	84.1	259	234.7	109.5
20	18.1	08.5	80	72.5	33.8	140	126.9	59.2	200	181.3	84.5	260	235.6	109.9
21	19.0	08.9	81	73.4	34.2	141	127.8	59.6	201	182.2	84.9	261	236.5	110.3
22	19.9	09.3	82	74.3	34.7	142	128.7	60.0	202	183.1	85.4	262	237.5	110.7
23	20.8	09.7	83	75.2	35.1	143	129.6	60.4	203	184.0	85.8	263	238.4	111.1
24	21.8	10.1	84	76.1	35.5	144	130.5	60.9	204	184.9	86.2	264	239.3	111.6
25	22.7	10.6	85	77.0	35.9	145	131.4	61.3	205	185.8	86.6	265	240.2	112.0
26	23.6	11.0	86	77.9	36.3	146	132.3	61.7	206	186.7	87.1	266	241.1	112.4
27	24.5	11.4	87	78.8	36.8	147	133.2	62.1	207	187.6	87.5	267	242.0	112.8
28	25.4	11.8	88	79.8	37.2	148	134.1	62.5	208	188.5	87.9	268	242.9	113.3
29	26.3	12.3	89	80.7	37.6	149	135.0	63.0	209	189.4	88.3	269	243.8	113.7
30	27.2	12.7	90	81.6	38.0	150	135.9	63.4	210	190.3	88.7	270	244.7	114.1
31	28.1	13.1	91	82.5	38.5	151	136.9	63.8	211	191.2	89.2	271	245.6	114.5
32	29.0	13.5	92	83.4	38.9	152	137.8	64.2	212	192.1	89.6	272	246.5	115.0
33	29.9	13.9	93	84.3	39.3	153	138·7	64.7	213	193.0	90.0	273	247.4	115.4
34	30.8	14.4	94	85.2	39.7	154	139.6	65.1	214	193.9	90.4	274	248.3	115.8
35	31.7	14.8	95	86.1	40.1	155	140.5	65.5	215	194.9	90.9	275	249.2	116.2
36	32.6	15.2	96	87.0	40.6	156	141.4	65.9	216	195.8	91.3	276	250.1	116.6
37	33.5	15.6	97	87.9	41.0	157	142.3	66.4	217	196.7	91.7	277	251.0	117.1
38	34.4	16.1	98	88.8	41.4	158	143.2	66.8	218	197.6	92.1	278	252.0	117.5
39	35.3	16.5	99	89.7	41.8	159	144.1	67.2	219	198.5	92.6	279	252.9	117.9
40	36.3	16.9	100	90.6	42.3	160	145.0	67.6	220	199.4	93.0	280	253.8	118.3
41	37.2	17.3	101	91.5	42.7	161	145.9	68.0	221	200.3	93.4	281	254.7	118.8
42	38.1	17.7	102	92.4	43.1	162	146.8	68.5	222	201.2	93.8	282	255.6	119.2
43	39.0	18.2	103	93.3	43.5	163	147.7	68.9	223	202.1	94.2	283	256.5	119.6
44	39.9	18.6	104	94.3	44.0	164	148.6	69.3	224	203.0	94.7	284	257.4	120.0
45	40.8	19.0	105	95.2	44.4	165	149.5	69.7	225	203.9	95.1	285	258.3	120.4
46	41.7	19.4	106	96.1	44.8	166	150.4	70.2	226	204.8	95.5	286	259.2	120.9
47	42.6	19.9	107	97.0	45.2	167	151.4	70.6	227	205.7	95.9	287	260.1	121.3
48	43.5	20.3	108	97.9	45.6	168	152.3	71.0	228	206.6	96.4	288	261.0	121.7
49	44.4	20.7	109	98.8	46.1	169	153.2	71.4	229	207.5	96.8	289	261.9	122.1
50	45.3	21.1	110	99.7	46.5	170	154.1	71.8	230	208.5	97.2	290	262.8	122.6
51	46.2	21 6	111	100.6	46.9	171	155.0	72.3	231	209.4	97.6	291	263.7	123.0
52	47.1	22.0	112	101.5	47.3	172	155.9	72.7	232	210.3	98.0	292	264.6	123.4
53	48.0	22.4	113	102.4	47.8	173	156.8	73.1	233	211.2	98.5	293	265.5	123.8
54	48.9	22.8	114	103.3	48.2	174	157.7	73.5	234	212.1	98.9	294	266.5	124.2
55	49.8	23.2	115	104.2	48.6	175	158.6	74.0	235	213.0	99.3	295	267.4	124.7
56	50.8	23.7	116	105.1	49.0	176	159.5	74.4	236	213.9	99.7	296	268.3	125.1
57	51.7	24.1	117	106.0	49.4	177	160.4	74.8	237	214.8	100.2	297	269 2	125.5
58	52.6	24.5	118	106.9	49.9	178	161.3	75.2	238	215.7	100.6	298	270.1	125.9
59	53.5	24.9	119	107.9	50.3	179	162.2	75 6	239	216.6	101.0	299	271.0	126.4
60	54.4	25.4	120	108.8	50.7	180	163.1	76.1	240	217.5	101.4	300	271.9	126.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

F

For 65 Degrees.

TABLE II.

Difference of Latitude and Departure for 26 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.4	61	54.8	26.7	121	108.8	53.0	181	162.7	79.3	241	216.6	105.6
2	01.8	00.9	62	55.7	27.2	122	109.7	53.5	182	163.6	79.8	242	217.5	106.1
3	02.7	01.3	63	56.6	27.6	123	110.6	53.9	183	164.5	80.2	243	218.4	106.5
4	03.6	01.8	64	57.5	28.1	124	111.5	54.4	184	165.4	80.7	244	219.3	107.0
5	04.5	02.2	65	58.4	28.5	125	112.3	54.8	185	166.3	81.1	245	220.2	107.4
6	05.4	02.6	66	59.3	28.9	126	113.2	55.2	186	167.2	81.5	246	221.1	107.8
7	06.3	03.1	67	60.2	29.4	127	114.1	55.7	187	168.1	82.0	247	222.0	108.3
8	07.2	03.5	68	61.1	29.8	128	115.0	56.1	188	169.0	82.4	248	222.9	108.7
9	08.1	03.9	69	62.0	30.2	129	115.9	56.5	189	169.9	82.9	249	223.8	109.2
10	09.0	04.4	70	62.9	30.7	130	116.8	57.0	190	170.8	83.3	250	224.7	109.6
11	09.9	04.8	71	63.8	31.1	131	117.7	57.4	191	171.7	83.7	251	225.6	110.0
12	10.8	05.3	72	64.7	31.6	132	118.6	57.9	192	172.6	84.2	252	226.5	110.5
13	11.7	05.7	73	65.6	32.0	133	119.5	58.3	193	173.5	84.6	253	227.4	110.9
14	12.6	06.1	74	66.5	32.4	134	120.4	58.7	194	174.4	85.0	254	228.3	111.3
15	13.5	06.6	75	67.4	32.9	135	121.3	59.2	195	175.3	85.5	255	229.2	111.8
16	14.4	07.0	76	68.3	33.3	136	122.2	59.6	196	176.2	85.9	256	230.1	112.2
17	15.3	07.5	77	69.2	33.8	137	123.1	60.1	197	177.1	86.4	257	231.0	112.7
18	16.2	07.9	78	70.1	34.2	138	124.0	60.5	198	178.0	86.8	258	231.9	113.1
19	17.1	08.3	79	71.0	34.6	139	124.9	60.9	199	178.9	87.2	259	232.8	113.5
20	18.0	08.8	80	71.9	35.1	140	125.8	61.4	200	179.8	87.7	260	233.7	114.0
21	18.9	09.2	81	72.8	35.5	141	126.7	61.8	201	180.7	88.1	261	234.6	114.4
22	19.8	09.6	82	73.7	35.9	142	127.6	62.2	202	181.6	88.6	262	235.5	114.9
23	20.7	10.1	83	74.6	36.4	143	128.5	62.7	203	182.5	89.0	263	236.4	115.3
24	21.6	10.5	84	75.5	36.8	144	129.4	63.1	204	183.4	89.4	264	237.3	115.7
25	22.5	11.0	85	76.4	37.3	145	130.3	63.6	205	184.3	89.9	265	238.2	116.2
26	23.4	11.4	86	77.3	37.7	146	131.2	64.0	206	185.2	90.3	266	239.1	116.6
27	24.3	11.8	87	78.2	38.1	147	132.1	64.4	207	186.1	90.7	267	240.0	117.0
28	25.2	12.3	88	79.1	38.6	148	133.0	64.9	208	186.9	91.2	268	240.9	117.5
29	26.1	12.7	89	80.0	39.0	149	133.9	65.3	209	187.8	91.6	269	241.8	117.9
30	27.0	13.2	90	80.9	39.5	150	134.8	65.8	210	188.7	92.1	270	242.7	118.4
31	27.9	13.6	91	81.8	39.9	151	135.7	66.2	211	189.6	92.5	271	243.6	118.8
32	28.8	14.0	92	82.7	40.3	152	136.6	66.6	212	190.5	92.9	272	244.5	119.2
33	29.7	14.5	93	83.6	40.8	153	137.5	67.1	213	191.4	93.4	273	245.4	119.7
34	30.6	14.9	94	84.5	41.2	154	138.4	67.5	214	192.3	93.8	274	246.3	120.1
35	31.5	15.3	95	85.4	41.6	155	139.3	67.9	215	193.2	94.2	275	247.2	120.6
36	32.4	15.8	96	86.3	42.1	156	140.2	68.4	216	194.1	94.7	276	248.1	121.0
37	33.3	16.2	97	87.2	42.5	157	141.1	68.8	217	195.0	95.1	277	249.0	121.4
38	34.2	16.7	98	88.1	43.0	158	142.0	69.3	218	195.9	95.6	278	249.9	121.9
39	35.1	17.1	99	89.0	43.4	159	142.9	69.7	219	196.8	96.0	279	250.8	122.3
40	36.0	17.5	100	89.9	43.8	160	143.8	70.1	220	197.7	96.4	280	251.7	122.7
41	36.9	18.0	101	90.8	44.3	161	144.7	70.6	221	198.6	96.9	281	252.6	123.2
42	37.7	18.4	102	91.7	44.7	162	145.6	71.0	222	199.5	97.3	282	253.5	123.6
43	38.6	18.8	103	92.6	45.2	163	146.5	71.5	223	200.4	97.8	283	254.4	124.1
44	39.5	19.3	104	93.5	45.6	164	147.4	71.9	224	201.3	98.2	284	255.3	124.5
45	40.4	19.7	105	94.4	46.0	165	148.3	72.3	225	202.2	98.6	285	256.2	124.9
46	41.3	20.2	106	95.3	46.5	166	149.2	72.8	226	203.1	99.1	286	257.1	125.4
47	42.2	20.6	107	96.2	46.9	167	150.1	73.2	227	204.0	99.5	287	258.0	125.8
48	43.1	21.0	108	97.1	47.3	168	151.0	73.6	228	204.9	99.9	288	258.9	126.3
49	44.0	21.5	109	98.0	47.8	169	151.9	74.1	229	205.8	100.4	289	259.8	126.7
50	44.9	21.9	110	98.9	48.2	170	152.8	74.5	230	206.7	100.8	290	260.7	127.1
51	45.8	22.4	111	99.8	48.7	171	153.7	75.0	231	207.6	101.3	291	261.5	127.6
52	46.7	22.8	112	100.7	49.1	172	154.6	75.4	232	208.5	101.7	292	262.4	128.0
53	47.6	23.2	113	101.6	49.5	173	155.5	75.8	233	209.4	102.1	293	263.3	128.4
54	48.5	23.7	114	102.5	50.0	174	156.4	76.3	234	210.3	102.6	294	264.2	128.9
55	49.4	24.1	115	103.4	50.4	175	157.3	76.7	235	211.2	103.0	295	265.1	129.3
56	50.3	24.5	116	104.3	50.9	176	158.2	77.2	236	212.1	103.5	296	266.0	129.8
57	51.2	25.0	117	105.2	51.3	177	159.1	77.6	237	213.0	103.9	297	266.9	130.2
58	52.1	25.4	118	106.1	51.7	178	160.0	78.0	238	213.9	104.3	298	267.8	130.6
59	53.0	25.9	119	107.0	52.2	179	160.9	78.5	239	214.8	104.8	299	268.7	131.1
60	53.9	26.3	120	107.9	52.6	180	161.8	78.9	240	215.7	105.2	300	269.6	131.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 64 Degrees.

TABLE II.

Difference of Latitude and Departure for 27 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	54.4	27.7	121	107.8	54.9	181	161.3	82.2	241	214.7	109.4
2	01.8	00.9	62	55.2	28.1	122	108.7	55.4	182	162.2	82.6	242	215.6	109.9
3	02.7	01.4	63	56.1	28.6	123	109.6	55.8	183	163.1	83.1	243	216.5	110.3
4	03.6	01.8	64	57.0	29.1	124	110.5	56.3	184	163.9	83.5	244	217.4	110.8
5	04.5	02.3	65	57.9	29.5	125	111.4	56.7	185	164.8	84.0	245	218.3	111.2
6	05.3	02.7	66	58.8	30.0	126	112.3	57.2	186	165.7	84.4	246	219.2	111.7
7	06.2	03.2	67	59.7	30.4	127	113.2	57.7	187	166.6	84.9	247	220.1	112.1
8	07.1	03.6	68	60.6	30.9	128	114.0	58.1	188	167.5	85.4	248	221.0	112.6
9	08.0	04.1	69	61.5	31.3	129	114.9	58.6	189	168.4	85.8	249	221.9	113.0
10	08.9	04.5	70	62.4	31.8	130	115.8	59.0	190	169.3	86.3	250	222.8	113.5
11	09.8	05.0	71	63.3	32.2	131	116.7	59.5	191	170.2	86.7	251	223.6	114.0
12	10.7	05.4	72	64.2	32.7	132	117.6	59.9	192	171.1	87.2	252	224.5	114.4
13	11.6	05.9	73	65.0	33.1	133	118.5	60.4	193	172.0	87.6	253	225.4	114.9
14	12.5	06.4	74	65.9	33.6	134	119.4	60.8	194	172.9	88.1	254	226.3	115.3
15	13.4	06.8	75	66.8	34.0	135	120.3	61.3	195	173.7	88.5	255	227.2	115.8
16	14.3	07.3	76	67.7	34.5	136	121.2	61.7	196	174.6	89.0	256	228.1	116.2
17	15.1	07.7	77	68.6	35.0	137	122.1	62.2	197	175.5	89.4	257	229.0	116.7
18	16.0	08.2	78	69.5	35.4	138	123.0	62.7	198	176.4	89.9	258	229.9	117.1
19	16.9	08.6	79	70.4	35.9	139	123.8	63.1	199	177.3	90.3	259	230.8	117.6
20	17.8	09.1	80	71.3	36.3	140	124.7	63.6	200	178.2	90.8	260	231.7	118.0
21	18.7	09.5	81	72.2	36.8	141	125.6	64.0	201	179.1	91.3	261	232.6	118.5
22	19.6	10.0	82	73.1	37.2	142	126.5	64.5	202	180.0	91.7	262	233.4	118.9
23	20.5	10.4	83	74.0	37.7	143	127.4	64.9	203	180.9	92.2	263	234.3	119.4
24	21.4	10.9	84	74.8	38.1	144	128.3	65.4	204	181.8	92.6	264	235.2	119.9
25	22.3	11.3	85	75.7	38.6	145	129.2	65.8	205	182.7	93.1	265	236.1	120.3
26	23.2	11.8	86	76.6	39.0	146	130.1	66.3	206	183.5	93.5	266	237.0	120.8
27	24.1	12.3	87	77.5	39.5	147	131.0	66.7	207	184.4	94.0	267	237.9	121.2
28	24.9	12.7	88	78.4	40.0	148	131.9	67.2	208	185.3	94.4	268	238.8	121.7
29	25.8	13.2	89	79.3	40.4	149	132.8	67.6	209	186.2	94.9	269	239.7	122.1
30	26.7	13.6	90	80.2	40.9	150	133.7	68.1	210	187.1	95.3	270	240.6	122.6
31	27.6	14.1	91	81.1	41.3	151	134.5	68.6	211	188.0	95.8	271	241.5	123.0
32	28.5	14.5	92	82.0	41.8	152	135.4	69.0	212	188.9	96.2	272	242.4	123.5
33	29.4	15.0	93	82.9	42.2	153	136.3	69.5	213	189.8	96.7	273	243.2	123.9
34	30.3	15.4	94	83.8	42.7	154	137.2	69.9	214	190.7	97.2	274	244.1	124.4
35	31.2	15.9	95	84.6	43.1	155	138.1	70.4	215	191.6	97.6	275	245.0	124.8
36	32.1	16.3	96	85.5	43.6	156	139.0	70.8	216	192.5	98.1	276	245.9	125.3
37	33.0	16.8	97	86.4	44.0	157	139.9	71.3	217	193.3	98.5	277	246.8	125.8
38	33.9	17.3	98	87.3	44.5	158	140.8	71.7	218	194.2	99.0	278	247.7	126.2
39	34.7	17.7	99	88.2	44.9	159	141.7	72.2	219	195.1	99.4	279	248.6	126.7
40	35.6	18.2	100	89.1	45.4	160	142.6	72.6	220	196.0	99.9	280	249.5	127.1
41	36.5	18.6	101	90.0	45.9	161	143.5	73.1	221	196.9	100.3	281	250.4	127.6
42	37.4	19.1	102	90.9	46.3	162	144.3	73.5	222	197.8	100.8	282	251.3	128.0
43	38.3	19.5	103	91.8	46.8	163	145.2	74.0	223	198.7	101.2	283	252.2	128.5
44	39.2	20.0	104	92.7	47.2	164	146.1	74.5	224	199.6	101.7	284	253.0	128.9
45	40.1	20.4	105	93.6	47.7	165	147.0	74.9	225	200.5	102.1	285	253.9	129.4
46	41.0	20.9	106	94.4	48.1	166	147.9	75.4	226	201.4	102.6	286	254.8	129.8
47	41.9	21.3	107	95.3	48.6	167	148.8	75.8	227	202.3	103.1	287	255.7	130.3
48	42.8	21.8	108	96.2	49.0	168	149.7	76.3	228	203.1	103.5	288	256.6	130.7
49	43.7	22.2	109	97.1	49.5	169	150.6	76.7	229	204.0	104.0	289	257.5	131.2
50	44.6	22.7	110	98.0	49.9	170	151.5	77.2	230	204.9	104.4	290	258.4	131.7
51	45.4	23.2	111	98.9	50.4	171	152.4	77.6	231	205.8	104.9	291	259.3	132.1
52	46.3	23.6	112	99.8	50.8	172	153.3	78.1	232	206.7	105.3	292	260.2	132.6
53	47.2	24.1	113	100.7	51.3	173	154.1	78.5	233	207.6	105.8	293	261.1	133.0
54	48.1	24.5	114	101.6	51.8	174	155.0	79.0	234	208.5	106.2	294	262.0	133.5
55	49.0	25.0	115	102.5	52.2	175	155.9	79.4	235	209.4	106.7	295	262.8	133.9
56	49.9	25.4	116	103.4	52.7	176	156.8	79.9	236	210.3	107.1	296	263.7	134.4
57	50.8	25.9	117	104.2	53.1	177	157.7	80.4	237	211.2	107.6	297	264.6	134.8
58	51.7	26.3	118	105.1	53.6	178	158.6	80.8	238	212.1	108.0	298	265.5	135.3
59	52.6	26.8	119	106.0	54.0	179	159.5	81.3	239	213.0	108.5	299	266.4	135.7
60	53.5	27.2	120	106.9	54.5	180	160.4	81.7	240	213.8	109.0	300	267.3	136.2
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 63 Degrees.

TABLE II.

Difference of Latitude and Departure for 28 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	53.9	28.6	121	106.8	56.8	181	159.8	85.0	241	212.8	113.1
2	01.8	00.9	62	54.7	29.1	122	107.7	57.3	182	160.7	85.4	242	213.7	113.6
3	02.6	01.4	63	55.6	29.6	123	108.6	57.7	183	161.6	85.9	243	214.6	114.1
4	03.5	01.9	64	56.5	30.0	124	109.5	58.2	184	162.5	86.4	244	215.4	114.6
5	04.4	02.3	65	57.4	30.5	125	110.4	58.7	185	163.3	86.9	245	216.3	115.0
6	05.3	02.8	66	58.3	31.0	126	111.3	59.2	186	164.2	87.3	246	217.2	115.5
7	06.2	03.3	67	59.2	31.5	127	112.1	59.6	187	165.1	87.8	247	218.1	116.0
8	07.1	03.8	68	60.0	31.9	128	113.0	60.1	188	166.0	88.3	248	219.0	116.4
9	07.9	04.2	69	60.9	32.4	129	113.9	60.6	189	166.9	88.7	249	219.9	116.9
10	08.8	04.7	70	61.8	32.9	130	114.8	61.0	190	167.8	89.2	250	220.7	117.4
11	09.7	05.2	71	62.7	33.3	131	115.7	61.5	191	168.6	89.7	251	221.6	117.9
12	10.6	05.6	72	63.6	33.8	132	116.5	62.0	192	169.5	90.1	252	222.5	118.3
13	11.5	06.1	73	64.5	34.3	133	117.4	62.4	193	170.4	90.6	253	223.4	118.8
14	12.4	06.6	74	65.3	34.7	134	118.3	62.9	194	171.3	91.1	254	224.3	119.2
15	13.2	07.0	75	66.2	35.2	135	119.2	63.4	195	172.2	91.5	255	225.2	119.7
16	14.1	07.5	76	67.1	35.7	136	120.1	63.8	196	173.1	92.0	256	226.0	120.2
17	15.0	08.0	77	68.0	36.1	137	121.0	64.3	197	173.9	92.5	257	226.9	120.7
18	15.9	08.5	78	68.9	36.6	138	121.8	64.8	198	174.8	93.0	258	227.8	121.1
19	16.8	08.9	79	69.8	37.1	139	122.7	65.3	199	175.7	93.4	259	228.7	121.6
20	17.7	09.4	80	70.6	37.6	140	123.6	65.7	200	176.6	93.9	260	229.6	122.1
21	18.5	09.9	81	71.5	38.0	141	124.5	66.2	201	177.5	94.4	261	230.4	122.5
22	19.4	10.3	82	72.4	38.5	142	125.4	66.7	202	178.4	94.8	262	231.3	123.0
23	20.3	10.8	83	73.3	39.0	143	126.3	67.1	203	179.2	95.3	263	232.2	123.5
24	21.2	11.3	84	74.2	39.4	144	127.1	67.6	204	180.1	95.8	264	233.1	123.9
25	22.1	11.7	85	75.1	39.9	145	128.0	68.1	205	181.0	96.2	265	234.0	124.4
26	23.0	12.2	86	75.9	40.4	146	128.9	68.5	206	181.9	96.7	266	234.9	124.9
27	23.8	12.7	87	76.8	40.8	147	129.8	69.0	207	182.8	97.2	267	235.7	125.3
28	24.7	13.1	88	77.7	41.3	148	130.7	69.5	208	183.7	97.7	268	236.6	125.8
29	25.6	13.6	89	78.6	41.8	149	131.6	70.0	209	184.5	98.1	269	237.5	126.3
30	26.5	14.1	90	79.5	42.3	150	132.4	70.4	210	185.4	98.6	270	238.4	126.8
31	27.4	14.6	91	80.3	42.7	151	133.3	70.9	211	186.3	99.1	271	239.3	127.2
32	28.3	15.0	92	81.2	43.2	152	134.2	71.4	212	187.2	99.5	272	240.2	127.7
33	29.1	15.5	93	82.1	43.7	153	135.1	71.8	213	188.1	100.0	273	241.0	128.2
34	30.0	16.0	94	83.0	44.1	154	136.0	72.3	214	189.0	100.5	274	241.9	128.6
35	30.9	16.4	95	83.9	44.6	155	136.9	72.8	215	189.8	100.9	275	242.8	129.1
36	31.8	16.9	96	84.8	45.1	156	137.7	73.2	216	190.7	101.4	276	243.7	129.6
37	32 7	17.4	97	85.6	45.5	157	138.6	73.7	217	191.6	101.9	277	244.6	130.0
38	33.6	17.8	98	86.5	46.0	158	139.5	74.2	218	192.5	102.3	278	245.5	130.5
39	34.4	18.3	99	87.4	46.5	159	140.4	74.6	219	193.4	102.8	279	246.3	131.0
40	35.3	18.8	100	88.3	46.9	160	141.3	75.1	220	194.2	103.3	280	247.2	131.5
41	36.2	19.2	101	89.2	47.4	161	142.2	75.6	221	195.1	103.8	281	248.1	131.9
42	37.1	19.7	102	90.1	47.9	162	143.0	76.1	222	196.0	104.2	282	249.0	132.4
43	38.0	20.2	103	90.9	48.4	163	143.9	76.5	223	196.9	104.7	283	249.9	132.9
44	38 8	20.7	104	91.8	48.8	164	144.8	77.0	224	197.8	105.2	284	250.8	133.3
45	39.7	21.1	105	92.7	49.3	165	145.7	77.5	225	198.7	105.6	285	251.6	133.8
46	40.6	21.6	106	93.6	49 8	166	146.6	77.9	226	199.5	106.1	286	252.5	134.3
47	41.5	22.1	107	94.5	50.2	167	147.5	78.4	227	200.4	106.6	287	253.4	134.7
48	42.4	22.5	108	95.4	50.7	168	148.3	78.9	228	201.3	107.0	288	254.3	135.2
49	43.3	23.0	109	96.2	51.2	169	149.2	79.3	229	202.2	107.5	289	255.2	135.7
50	44.1	23.5	110	97.1	51.6	170	150.1	79.8	230	203.1	108.0	290	256.1	136.1
51	45.0	23.9	111	98.0	52.1	171	151.0	80.3	231	204.0	108.4	291	256.9	136.6
52	45.9	24.4	112	98.9	52.6	172	151.9	80.7	232	204.8	108.9	292	257.8	137.1
53	46.8	24.9	113	99.8	53.1	173	152.7	81.2	233	205.7	109.4	293	258.7	137.6
54	47.7	25.4	114	100.7	53.5	174	153.6	81.7	234	206.6	109.9	294	259.6	138.0
55	48.6	25.8	115	101.5	54.0	175	154.5	82.2	235	207.5	110.3	295	260.5	138.5
56	49.4	26.3	116	102.4	54.5	176	155.4	82.6	236	208.4	110.8	296	261.3	139.0
57	50.3	26.8	117	103.3	54.9	177	156.3	83.1	237	209.3	111.3	297	262.2	139.4
58	51.2	27.2	118	104.2	55.4	178	157.2	83.6	238	210.1	111.7	298	263.1	139.9
59	52.1	27.7	119	105.1	55.9	179	158.0	84.0	239	211.0	112.2	299	264.0	140.4
60	53.0	28.2	120	106.0	56.3	180	158.9	84.5	240	211.9	112.7	300	264.9	140.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 62 Degrees.

TABLE II.

Difference of Latitude and Departure for 29 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	53.4	29.6	121	105.8	58.7	181	158.3	87.8	241	210.8	116.8
2	01.7	01.0	62	54.2	30.1	122	106.7	59.1	182	159.2	88.2	242	211.7	117.3
3	02.6	01.5	63	55.1	30.5	123	107.6	59.6	183	160.1	88.7	243	212.5	117.8
4	03.5	01.9	64	56.0	31.0	124	108.5	60.1	184	160.9	89.2	244	213.4	118.3
5	04.4	02.4	65	56.9	31.5	125	109.3	60.6	185	161.8	89.7	245	214.3	118.8
6	05.2	02.9	66	57.7	32.0	126	110.2	61.1	186	162.7	90.2	246	215.2	119.3
7	06.1	03.4	67	58.6	32.5	127	111.1	61.6	187	163.6	90.7	247	216.0	119.7
8	07.0	03.9	68	59.5	33.0	128	112.0	62.1	188	164.4	91.1	248	216.9	120.2
9	07.9	04.4	69	60.3	33.5	129	112.8	62.5	189	165.3	91.6	249	217.8	120.7
10	08.7	04.8	70	61.2	33.9	130	113.7	63.0	190	166.2	92.1	250	218.7	121.2
11	09.6	05.3	71	62.1	34.4	131	114.6	63.5	191	167.1	92.6	251	219.5	121.7
12	10.5	05.8	72	63.0	34.9	132	115.4	64.0	192	167.9	93.1	252	220.4	122.2
13	11.4	06.3	73	63.8	35.4	133	116.3	64.5	193	168.8	93.6	253	221.3	122.7
14	12.2	06.8	74	64.7	35.9	134	117.2	65.0	194	169.7	94.1	254	222.2	123.1
15	13.1	07.3	75	65.6	36.4	135	118.1	65.4	195	170.6	94.5	255	223.0	123.6
16	14.0	07.8	76	66.5	36.8	136	118.9	65.9	196	171.4	95.0	256	223.9	124.1
17	14.9	08.2	77	67.3	37.3	137	119.8	66.4	197	172.3	95.5	257	224.8	124.6
18	15.7	08.7	78	68.2	37.8	138	120.7	66.9	198	173.2	96.0	258	225.7	125.1
19	16.6	09.2	79	69.1	38.3	139	121.6	67.4	199	174.0	96.5	259	226.5	125.6
20	17.5	09.7	80	70.0	38.8	140	122.4	67.9	200	174.9	97.0	260	227.4	126.1
21	18.4	10.2	81	70.8	39.3	141	123.3	68.4	201	175.8	97.4	261	228.3	126.5
22	19.2	10.7	82	71.7	39.8	142	124.2	68.8	202	176.7	97.9	262	229.2	127.0
23	20.1	11.2	83	72.6	40.2	143	125.1	69.3	203	177.5	98.4	263	230.0	127.5
24	21.0	11.6	84	73.5	40.7	144	125.9	69.8	204	178.4	98.9	264	230.9	128.0
25	21.9	12.1	85	74.3	41.2	145	126.8	70.3	205	179.3	99.4	265	231.8	128.5
26	22.7	12.6	86	75.2	41.7	146	127.7	70.8	206	180.2	99.9	266	232.6	129.0
27	23.6	13.1	87	76.1	42.2	147	128.6	71.3	207	181.0	100.4	267	233.5	129.4
28	24.5	13.6	88	77.0	42.7	148	129.4	71.8	208	181.9	100.8	268	234.4	129.9
29	25.4	14.1	89	77.8	43.1	149	130.3	72.2	209	182.8	101.3	269	235.3	130.4
30	26.2	14.5	90	78.7	43.6	150	131.2	72.7	210	183.7	101.8	270	236.1	130.9
31	27.1	15.0	91	79.6	44.1	151	132.1	73.2	211	184.5	102.3	271	237.0	131.4
32	28.0	15.5	92	80.5	44.6	152	132.9	73.7	212	185.4	102.8	272	237.9	131.9
33	28.9	16.0	93	81.3	45.1	153	133.8	74.2	213	186.3	103.3	273	238.8	132.4
34	29.7	16.5	94	82.2	45.6	154	134.7	74.7	214	187.2	103.7	274	239.6	132.8
35	30.6	17.0	95	83.1	46.1	155	135.6	75.1	215	188.0	104.2	275	240.5	133.3
36	31.5	17.5	96	84.0	46.5	156	136.4	75.6	216	188.9	104.7	276	241.4	133.8
37	32.4	17.9	97	84.8	47.0	157	137.3	76.1	217	189.8	105.2	277	242.3	134.3
38	33.2	18.4	98	85.7	47.5	158	138.2	76.6	218	190.7	105.7	278	243.1	134.8
39	34.1	18.9	99	86.6	48.0	159	139·1	77.1	219	191.5	106.2	279	244.0	135.3
40	35.0	19.4	100	87.5	48.5	160	139.9	77.6	220	192.4	106.7	280	244.9	135.7
41	35.9	19.9	101	88.3	49.0	161	140.8	78.1	221	193.3	107.1	281	245.8	136.2
42	36.7	20.4	102	89.2	49.5	162	141.7	78.5	222	194.2	107.6	282	246.6	136.7
43	37.6	20.8	103	90.1	49.9	163	142.6	79.0	223	195.0	108.1	283	247.5	137.2
44	38.5	21.3	104	91.0	50.4	164	143.4	79.5	224	195.9	108.6	284	248.4	137.7
45	39.4	21 8	105	91.8	50.9	165	144.3	80.0	225	196.8	109.1	285	249.3	138.2
46	40.2	22.3	106	92.7	51.4	166	145.2	80.5	226	197.7	109.6	286	250.1	138.7
47	41.1	22.8	107	93.6	51.9	167	146.1	81.0	227	198.5	110.1	287	251.0	139.1
48	42.0	23.3	108	94.5	52.4	168	146.9	81.4	228	199.4	110.5	288	251.9	139.6
49	42.9	23.8	109	95.3	52.8	169	147.8	81.9	229	200.3	111.0	289	252.8	140.1
50	43.7	24.2	110	96.2	53.3	170	148.7	82.4	230	201.2	111.5	290	253.6	140.6
51	44.6	24.7	111	97.1	53.8	171	149.6	82.9	231	202.0	112.0	291	254.5	141.1
52	45.5	25.2	112	98.0	54.3	172	150.4	83.4	232	202.9	112.5	292	255.4	141.6
53	46.4	25.7	113	98.8	54.8	173	151.3	83.9	233	203.8	113.0	293	256.3	142.0
54	47.2	26.2	114	99.7	55.3	174	152.2	84.4	234	204.7	113.4	294	257.1	142.5
55	48.1	26.7	115	100.6	55.8	175	153.1	84.8	235	205.5	113.9	295	258.0	143.0
56	49.0	27.1	116	101.5	56.2	176	153.9	85.3	236	206.4	114.4	296	258.9	143.5
57	49.9	27.6	117	102.3	56.7	177	154.8	85.8	237	207.3	114.9	297	259.8	144.0
58	50.7	28.1	118	103.2	57.2	178	155.7	86.3	238	208.2	115.4	298	260.6	144.5
59	51.6	28.6	119	104.1	57.7	179	156.6	86.8	239	209.0	115.9	299	261.5	145.0
60	52.5	29.1	120	105.0	58.2	180	157.4	87.3	240	209.9	116.4	300	262.4	145.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 61 Degrees.

TABLE II.

Difference of Latitude and Departure for 30 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	52.8	30.5	121	104.8	60.5	181	156.8	90.5	241	208.7	120.5
2	01.7	01.0	62	53.7	31.0	122	105.7	61.0	182	157.6	91.0	242	209.6	121.0
3	02.6	01.5	63	54.6	31.5	123	106.5	61.5	183	158.5	91.5	243	210.4	121.5
4	03.5	02.0	64	55.4	32.0	124	107.4	62.0	184	159.3	92.0	244	211.3	122.0
5	04.3	02.5	65	56.3	32.5	125	108.3	62.5	185	160.2	92.5	245	212.2	122.5
6	05.2	03.0	66	57.2	33.0	126	109.1	63.0	186	161.1	93.0	246	213.0	123.0
7	06.1	03.5	67	58.0	33.5	127	110.0	63.5	187	161.9	93.5	247	213.9	123.5
8	06.9	04.0	68	58.9	34.0	128	110.9	64.0	188	162.8	94.0	248	214.8	124.0
9	07.8	04.5	69	59.8	34.5	129	111.7	64.5	189	163.7	94.5	249	215.6	124.5
10	08.7	05.0	70	60.6	35.0	130	112.6	65.0	190	164.5	95.0	250	216.5	125.0
11	09.5	05.5	71	61.5	35.5	131	113.4	65.5	191	165.4	95.5	251	217.4	125.5
12	10.4	06.0	72	62.4	36.0	132	114.3	66.0	192	166.3	96.0	252	218.2	126.0
13	11.3	06.5	73	63.2	36.5	133	115.2	66.5	193	167.1	96.5	253	219.1	126.5
14	12.1	07.0	74	64.1	37.0	134	116.0	67.0	194	168.0	97.0	254	220.0	127.0
15	13.0	07.5	75	65.0	37.5	135	116.9	67.5	195	168.9	97.5	255	220.8	127.5
16	13.9	08.0	76	65.8	38.0	136	117.8	68.0	196	169.7	98.0	256	221.7	128.0
17	14.7	08.5	77	66.7	38.5	137	118.6	68.5	197	170.6	98.5	257	222.6	128.5
18	15.6	09.0	78	67.5	39.0	138	119.5	69.0	198	171.5	99.0	258	223.4	129.0
19	16.5	09.5	79	68.4	39.5	139	120.4	69.5	199	172.3	99.5	259	224.3	129.5
20	17.3	10.0	80	69.3	40.0	140	121.2	70.0	200	173.2	100.0	260	225.2	130.0
21	18.2	10.5	81	70.1	40.5	141	122.1	70.5	201	174.1	100.5	261	226.0	130.5
22	19.1	11.0	82	71.0	41.0	142	123.0	71.0	202	174.9	101.0	262	226.9	131.0
23	19.9	11.5	83	71.9	41.5	143	123.8	71.5	203	175.8	101.5	263	227.8	131.5
24	20.8	12.0	84	72.7	42.0	144	124.7	72.0	204	176.7	102.0	264	228.6	132.0
25	21.7	12.5	85	73.6	42.5	145	125.6	72.5	205	177.5	102.5	265	229.5	132.5
26	22.5	13.0	86	74.5	43.0	146	126.4	73.0	206	178.4	103.0	266	230.4	133.0
27	23.4	13.5	87	75.3	43.5	147	127.3	73.5	207	179.3	103.5	267	231.2	133.5
28	24.2	14.0	88	76.2	44.0	148	128.2	74.0	208	180.1	104.0	268	232.1	134.0
29	25.1	14.5	89	77.1	44.5	149	129.0	74.5	209	181.0	104.5	269	233.0	134.5
30	26.0	15.0	90	77.9	45.0	150	129.9	75.0	210	181.9	105.0	270	233.8	135.0
31	26.8	15.5	91	78.8	45.5	151	130.8	75.5	211	182.7	105.5	271	234.7	135.5
32	27.7	16.0	92	79.7	46.0	152	131.6	76.0	212	183.6	106.0	272	235.6	136.0
33	28.6	16.5	93	80.5	46.5	153	132.5	76.5	213	184.5	106.5	273	236.4	136.5
34	29.4	17.0	94	81.4	47.0	154	133.4	77.0	214	185.3	107.0	274	237.3	137.0
35	30.3	17.5	95	82.3	47.5	155	134.2	77.5	215	186.2	107.5	275	238.2	137.5
36	31.2	18.0	96	83.1	48.0	156	135.1	78.0	216	187.1	108.0	276	239.0	138.0
37	32.0	18.5	97	84.0	48.5	157	136.0	78.5	217	187.9	108.5	277	239.9	138.5
38	32.9	19.0	98	84.9	49.0	158	136.8	79.0	218	188.8	109.0	278	240.8	139.0
39	33.8	19.5	99	85.7	49.5	159	137.7	79.5	219	189.7	109.5	279	241.6	139.5
40	34.6	20.0	100	86.6	50.0	160	138.6	80.0	220	190.5	110.0	280	242.5	140.0
41	35.5	20.5	101	87.5	50.5	161	139.4	80.5	221	191.4	110.5	281	243.4	140.5
42	36.4	21.0	102	88.3	51.0	162	140.3	81.0	222	192.3	111.0	282	244.2	141.0
43	37.2	21.5	103	89.2	51.5	163	141.2	81.5	223	193.1	111.5	283	245.1	141.5
44	38.1	22.0	104	90.1	52.0	164	142.0	82.0	224	194.0	112.0	284	246.0	142.0
45	39.0	22.5	105	90.9	52.5	165	142.9	82.5	225	194.9	112.5	285	246.8	142.5
46	39.8	23.0	106	91.8	53.0	166	143.8	83.0	226	195.7	113.0	286	247.7	143.0
47	40.7	23.5	107	92.7	53.5	167	144.6	83.5	227	196.6	113.5	287	248.5	143.5
48	41.6	24.0	108	93.5	54.0	168	145.5	84.0	228	197.5	114.0	288	249.4	144.0
49	42.4	24.5	109	94.4	54.5	169	146.4	84.5	229	198.3	114.5	289	250.3	144.5
50	43.3	25.0	110	95.3	55.0	170	147.2	85.0	230	199.2	115.0	290	251.1	145.0
51	44.2	25.5	111	96.1	55.5	171	148.1	85.5	231	200.1	115.5	291	252.0	145.5
52	45.0	26.0	112	97.0	56.0	172	149.0	86.0	232	200.9	116.0	292	252.9	146.0
53	45.9	26.5	113	97.9	56.5	173	149.8	86.5	233	201.8	116.5	293	253.7	146.5
54	46.8	27.0	114	98.7	57.0	174	150.7	87.0	234	202.6	117.0	294	254.6	147.0
55	47.6	27.5	115	99.6	57.5	175	151.6	87.5	235	203.5	117.5	295	255.5	147.5
56	48.5	28.0	116	100.5	58.0	176	152.4	88.0	236	204.4	118.0	296	256.3	148.0
57	49.4	28.5	117	101.3	58.5	177	153.3	88.5	237	205.2	118.5	297	257.2	148.5
58	50.2	29.0	118	102.2	59.0	178	154.2	89.0	238	206.1	119.0	298	258.1	149.0
59	51.1	29.5	119	103.1	59.5	179	155.0	89.5	239	207.0	119.5	299	258.9	149.5
60	52.0	30.0	120	103.9	60.0	180	155.9	90.0	240	207.8	120.0	300	259.8	150.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 60 Degrees.

Difference of Latitude and Departure for 31 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.9	00.5	61	52.3	31.4	121	103.7	62.3	181	155.1	93.2	241	206.6	124.1
2	01.7	01.0	62	53.1	31.9	122	104.6	62.8	182	156.0	93.7	242	207.4	124.6
3	02.6	01.5	63	54.0	32.4	123	105.4	63.3	183	156.9	94.3	243	208.3	125.2
4	03.4	02.1	64	54.9	33.0	124	106.3	63.9	184	157.7	94.8	244	209.1	125.7
5	04.3	02.6	65	55.7	33.5	125	107.1	64.4	185	158.6	95.3	245	210.0	126.2
6	05.1	03.1	66	56.6	34.0	126	108.0	64.9	186	159.4	95.8	246	210.9	126.7
7	06.0	03.6	67	57.4	34.5	127	108.9	65.4	187	160.3	96.3	247	211.7	127.2
8	06.9	04.1	68	58.3	35.0	128	109.7	65.9	188	161.1	96.8	248	212.6	127.7
9	07.7	04.6	69	59.1	35.5	129	110.6	66.4	189	162.0	97.3	249	213.4	128.2
10	08.6	05.2	70	60.0	36.1	130	111.4	67.0	190	162.9	97.9	250	214.3	128.8
11	09.4	05.7	71	60.9	36.6	131	112.3	67.5	191	163.7	98.4	251	215.1	129.3
12	10.3	06.2	72	61.7	37.1	132	113.1	68.0	192	164.6	98.9	252	216.0	129.8
13	11.1	06.7	73	62.6	37.6	133	114.0	68.5	193	165.4	99.4	253	216.9	130.3
14	12.0	07.2	74	63.4	38.1	134	114.9	69.0	194	166.3	99.9	254	217.7	130.8
15	12.9	07.7	75	64.3	38.6	135	115.7	69.5	195	167.1	100.4	255	218.6	131.3
16	13.7	08.2	76	65.1	39.1	136	116.6	70.0	196	168.0	100.9	256	219.4	131.8
17	14.6	08.8	77	66.0	39.7	137	117.4	70.6	197	168.9	101.5	257	220.3	132.4
18	15.4	09.3	78	66.9	40.2	138	118.3	71.1	198	169.7	102.0	258	221.1	132.9
19	16.3	09.8	79	67.7	40.7	139	119.1	71.6	199	170.6	102.5	259	222.0	133.4
20	17.1	10.3	80	68.6	41.2	140	120.0	72.1	200	171.4	103.0	260	222.9	133.9
21	18.0	10.8	81	69.4	41.7	141	120.9	72.6	201	172.3	103.5	261	223.7	134.4
22	18.9	11.3	82	70.3	42.2	142	121.7	73.1	202	173.1	104.0	262	224.6	134.9
23	19.7	11.8	83	71.1	42.7	143	122.6	73.7	203	174.0	104.6	263	225.4	135.5
24	20.6	12.4	84	72.0	43.3	144	123.4	74.2	204	174.9	105.1	264	226.3	136.0
25	21.4	12.9	85	72.9	43.8	145	124.3	74.7	205	175.7	105.6	265	227.1	136.5
26	22.3	13.4	86	73.7	44.3	146	125.1	75.2	206	176.6	106.1	266	228.0	137.0
27	23.1	13.9	87	74.6	44.8	147	126.0	75.7	207	177.4	106.6	267	228.9	137.5
28	24.0	14.4	88	75.4	45.3	148	126.9	76.2	208	178.3	107.1	268	229.7	138.0
29	24.9	14.9	89	76.3	45.8	149	127.7	76.7	209	179.1	107.6	269	230.6	138.5
30	25.7	15.5	90	77.1	46.4	150	128.6	77.3	210	180.0	108.2	270	231.4	139.1
31	26.6	16.0	91	78.0	46.9	151	129.4	77.8	211	180.9	108.7	271	232.3	139.6
32	27.4	16.5	92	78.9	47.4	152	130.3	78.3	212	181.7	109.2	272	233.1	140.1
33	28.3	17.0	93	79.7	47.9	153	131.1	78.8	213	182.6	109.7	273	234.0	140.6
34	29.1	17.5	94	80.6	48.4	154	132.0	79.3	214	183.4	110.2	274	234.9	141.1
35	30.0	18.0	95	81.4	48.9	155	132.9	79.8	215	184.3	110.7	275	235.7	141.6
36	30.9	18.5	96	82.3	49.4	156	133.7	80.3	216	185.1	111.2	276	236.6	142.2
37	31.7	19.1	97	83.1	50.0	157	134.6	80.9	217	186.0	111.8	277	237.4	142 7
38	32.6	19.6	98	84.0	50.5	158	135.4	81.4	218	186.9	112.3	278	238.3	143 2
39	33.4	20.1	99	84.9	51.0	159	136.3	81.9	219	187.7	112.8	279	239.1	143.7
40	34.3	20.6	100	85.7	51.5	160	137.1	82.4	220	188.6	113.3	280	240.0	144.2
41	35.1	21.1	101	86.6	52.0	161	138.0	82.9	221	189.4	113.8	281	240.9	144.7
42	36.0	21.6	102	87.4	52.5	162	138.9	83.4	222	190.3	114.3	282	241.7	145.2
43	36.9	22.1	103	88.3	53.0	163	139.7	84.0	223	191.1	114.9	283	242.6	145.8
44	37.7	22.7	104	89.1	53.6	164	140·6	84.5	224	192.0	115.4	284	243.4	146.3
45	38.6	23.2	105	90.0	54.1	165	141.4	85.0	225	192.9	115.9	285	244.3	146.8
46	39.4	23.7	106	90.9	54.6	166	142.3	85.5	226	193.7	116.4	286	245.1	147.3
47	40.3	24.2	107	91.7	55.1	167	143.1	86.0	227	194.6	116.9	287	246.0	147.8
48	41.1	24.7	108	92.6	55.6	168	144.0	86.5	228	195.4	117.4	288	246.9	148.3
49	42.0	25.2	109	93.4	56.1	169	144.9	87.0	229	196.3	117.9	289	247.7	148.8
50	42.9	25.8	110	94.3	56.7	170	145.7	87.6	230	197.1	118.5	290	248.6	149.4
51	43.7	26.3	111	95.1	57.2	171	146.6	88.1	231	198.0	119.0	291	249.4	149.9
52	44.6	26.8	112	96.0	57.7	172	147.4	88.6	232	198.9	119.5	292	250.3	150.4
53	45.4	27.3	113	96.9	58.2	173	148.3	89.1	233	199.7	120.0	293	251.2	150.9
54	46.3	27.8	114	97.7	58.7	174	149.1	89.6	234	200.6	120.5	294	252.0	151.4
55	47.1	28.3	115	98.6	59.2	175	150.0	90.1	235	201.4	121.0	295	252.9	151.9
56	48.0	28.8	116	99.4	59.7	176	150.9	90.6	236	202.3	121.5	296	253.7	152.5
57	48.9	29.4	117	100.3	60.3	177	151.7	91.2	237	203.1	122.1	297	254.6	153.0
58	49.7	29.9	118	101.1	60.8	178	152.6	91.7	238	204.0	122.6	298	255.4	153.5
59	50.6	30.4	119	102.0	61.3	179	153.4	92.2	239	204.9	123.1	299	256.3	154.0
60	51.4	30.9	120	102.9	61.8	180	154.3	92.7	240	205.7	123.6	300	257.1	154.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 59 Degrees.

TABLE II.

Difference of Latitude and Departure for 32 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.5	61	51.7	32.3	121	102.6	64.1	181	153.5	95.9	241	204.4	127.7
2	01.7	01.1	62	52.6	32.9	122	103.5	64.7	182	154.3	96.4	242	205.2	128.2
3	02.5	01.6	63	53.4	33.4	123	104.3	65.2	183	155.2	97.0	243	206.1	128.8
4	03.4	02.1	64	54.3	33.9	124	105.2	65.7	184	156.0	97.5	244	206.9	129.3
5	04.2	02.6	65	55.1	34.4	125	106.0	66.2	185	156.9	98.0	245	207.8	129.8
6	05.1	03.2	66	56.0	35.0	126	106.9	66.8	186	157.7	98.6	246	208.6	130.4
7	05.9	03.7	67	56.8	35.5	127	107.7	67.3	187	158.6	99.1	247	209.5	130.9
8	06.8	04.2	68	57.7	36.0	128	108.6	67.8	188	159.4	99.6	248	210.3	131.4
9	07.6	04.8	69	58.5	36.6	129	109.4	68.4	189	160.3	100.2	249	211.2	131.9
10	08.5	05.3	70	59.4	37.1	130	110.2	68.9	190	161.1	100.7	250	212.0	132.5
11	09.3	05.8	71	60.2	37.6	131	111.1	69.4	191	162.0	191.2	251	212.9	133.0
12	10.2	06.4	72	61.1	38.2	132	111.9	69.9	192	162.8	101.7	252	213.7	133.5
13	11.0	06.9	73	61.9	38.7	133	112.8	70.5	193	163.7	102.3	253	214.6	134.1
14	11.9	07.4	74	62.8	39.2	134	113.6	71.0	194	164.5	102.8	254	215.4	134.6
15	12.7	07.9	75	63.6	39.7	135	114.5	71.5	195	165.4	103.3	255	216.3	135.1
16	13.6	08.5	76	64.5	40.3	136	115.3	72.1	196	166.2	103.9	256	217.1	135.7
17	14.4	09.0	77	65.3	40.8	137	116.2	72.6	197	167.1	104.4	257	217.9	136.2
18	15.3	09.5	78	66.1	41.3	138	117.0	73.1	198	167.9	104.9	258	218.8	136.7
19	16.1	10.1	79	67.0	41.9	139	117.9	73.7	199	168.8	105.5	259	219.6	137.2
20	17.0	10.6	80	67.8	42.4	140	118.7	74.2	200	169.6	106.0	260	220.5	137.8
21	17.8	11.1	81	68.7	42.9	141	119.6	74.7	201	170.5	106.5	261	221.3	138.3
22	18.7	11.7	82	69.5	43.5	142	120.4	75.2	202	171.3	107.0	262	222.2	138.8
23	19.5	12.2	83	70.4	44.0	143	121.3	75.8	203	172.2	107.6	263	223.0	139.4
24	20.4	12.7	84	71.2	44.5	144	122.1	76.3	204	173.0	108.1	264	223.9	139.9
25	21.2	13.2	85	72.1	45.0	145	123.0	76.8	205	173.8	108.6	265	224.7	140.4
26	22.0	13.8	86	72.9	45.6	146	123.8	77.4	206	174.7	109.2	266	225.6	141.0
27	22.9	14.3	87	73.8	46.1	147	124.7	77.9	207	175.5	109.7	267	226.4	141.5
28	23.7	14.8	88	74.6	46.6	148	125.5	78.4	208	176.4	110.2	268	227.3	142.0
29	24.6	15.4	89	75.5	47.2	149	126.4	79.0	209	177.2	110.8	269	228.1	142.5
30	25.4	15.9	90	76.3	47.7	150	127.2	79.5	210	178.1	111.3	270	229.0	143.1
31	26.3	16.4	91	77.2	48.2	151	128.1	80.0	211	178.9	111.8	271	229.8	143.6
32	27.1	17.0	92	78.0	48.8	152	128.9	80.5	212	179.8	112.3	272	230.7	144.1
33	28.0	17.5	93	78.9	49.3	153	129.8	81.1	213	180.6	112.9	273	231.5	144.7
34	28.8	18.0	94	79.7	49.8	154	130.6	81.6	214	181.5	113.4	274	232.4	145.2
35	29.7	18.5	95	80.6	50.3	155	131.4	82.1	215	182.3	113.9	275	233.2	145.7
36	30.5	19.1	96	81.4	50.9	156	132.3	82.7	216	183.2	114.5	276	234.1	146.3
37	31.4	19.6	97	82.3	51.4	157	133.1	83.2	217	184.0	115.0	277	234.9	146.8
38	32.2	20.1	98	83.1	51.9	158	134.0	83.7	218	184.9	115.5	278	235.8	147.3
39	33 1	20.7	99	84.0	52.5	159	134.8	84.3	219	185.7	116.1	279	236.6	147.8
40	33.9	21.2	100	84.8	53.0	160	135.7	84.8	220	186.6	116.6	280	237.5	148.4
41	34.8	21.7	101	85.7	53.5	161	136.5	85.3	221	187.4	117.1	281	238.3	148.9
42	35.6	22.3	102	86.5	54.1	162	137.4	85.8	222	188.3	117.6	282	239.1	149.4
43	36.5	22.8	103	87.3	54.6	163	138.2	86.4	223	189.1	118.2	283	240.0	150.0
44	37.3	23.3	104	88.2	55.1	164	139.1	86.9	224	190.0	118.7	284	240.8	150.5
45	38.2	23.8	105	89.0	55.6	165	139.9	87.4	225	190.8	119.2	285	241.7	151.0
46	39.0	24.4	106	89.9	56.2	166	140.8	88.0	226	191.7	119.8	286	242.5	151.6
47	39.9	24.9	107	90.7	56.7	167	141.6	88.5	227	192.5	120.3	287	243.4	152.1
48	40.7	25.4	108	91.6	57.2	168	142.5	89.0	228	193.4	120.8	288	244.2	152.6
49	41.6	26.0	109	92.4	57.8	169	143.3	89.6	229	194.2	121.4	289	245.1	153.1
50	42.4	26.5	110	93.3	58.3	170	144.2	90.1	230	195.1	121.9	290	245.9	153.7
51	43.3	27.0	111	94.1	58.8	171	145.0	90.6	231	195.9	122.4	291	246.8	154.2
52	44.1	27.6	112	95.0	59.4	172	145.9	91.1	232	196.7	122.9	292	247.6	154.7
53	44.9	28.1	113	95.8	59.9	173	146.7	91.7	233	197.6	123.5	293	248.5	155.3
54	45.8	28.6	114	96.7	60.4	174	147.6	92.2	234	198.4	124.0	294	249.3	155.8
55	46.6	29.1	115	97.5	60.9	175	148.4	92.7	235	199.3	124.5	295	250.2	156.3
56	47.5	29.7	116	98.4	61.5	176	149.3	93.3	236	200.1	125.1	296	251.0	156.9
57	48.3	30.2	117	99.2	62.0	177	150.1	93.8	237	201.0	125.6	297	251.9	157.4
58	49.2	30.7	118	100.1	62.5	178	151.0	94.3	238	201.8	126.1	298	252.7	157.9
59	50.0	31.3	119	100.9	63.1	179	151.8	94.9	239	202.7	126.7	299	253·6	158.4
60	50.9	31.8	120	101.8	63.6	180	152.6	95.4	240	203.5	127.2	300	254.4	159.0
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 58 Degrees.

TABLE II.

Difference of Latitude and Departure for 33 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.5	61	51.2	33.2	121	101.5	65.9	181	151.8	98.6	241	202.1	131.3
2	01.7	01.1	62	52.0	33.8	122	102.3	66.4	182	152.6	99.1	242	203.0	131.8
3	02.5	01.6	63	52.8	34.3	123	103.2	67.0	183	153.5	99.7	243	203.8	132.3
4	03.4	02.2	64	53.7	34.9	124	104.0	67.5	184	154.3	100.2	244	204.6	132.9
5	04.2	02.7	65	54.5	35.4	125	104.8	68.1	185	155.2	100.8	245	205.5	133.4
6	05.0	03.3	66	55.4	35.9	126	105.7	68.6	186	156.0	101.3	246	206.3	134.0
7	05.9	03.8	67	56.2	36.5	127	106.5	69.2	187	156.8	101.8	247	207.2	134.5
8	06.7	04.4	68	57.0	37.0	128	107.3	69.7	188	157.7	102.4	248	208.0	135.1
9	07.5	04.9	69	57.9	37.6	129	108.2	70.3	189	158.5	102.9	249	208.8	135.6
10	08.4	05.4	70	58.7	38.1	130	109.0	70.8	190	159.3	103.5	250	209.7	136.2
11	09.2	06.0	71	59.5	38.7	131	109.9	71.3	191	160.2	104.0	251	210.5	136.7
12	10.1	06.5	72	60.4	39.2	132	110.7	71.9	192	161.0	104.6	252	211.3	137.2
13	10.9	07.1	73	61.2	39.8	133	111.5	72.4	193	161.9	105.1	253	212.2	137.8
14	11.7	07.6	74	62.1	40.3	134	112.4	73.0	194	162.7	105.7	254	213.0	138.3
15	12.6	08.2	75	62.9	40.8	135	113.2	73.5	195	163.5	106.2	255	213.9	138.9
16	13.4	08.7	76	63.7	41.4	136	114.1	74.1	196	164.4	106.7	256	214.7	139.4
17	14.3	09.3	77	64.6	41.9	137	114.9	74.6	197	165.2	107.3	257	215.5	140.0
18	15.1	09.8	78	65.4	42.5	138	115.7	75.2	198	166.1	107.8	258	216.4	140.5
19	15.9	10.3	79	66.3	43.0	139	116.6	75.7	199	166.9	108.4	259	217.2	141.1
20	16.8	10.9	80	67.1	43.6	140	117.4	76.2	200	167.7	108.9	260	218.1	141.6
21	17.6	11.4	81	67.9	44.1	141	118.3	76.8	201	168.6	109.5	261	218.9	142.2
22	18.5	12.0	82	68.8	44.7	142	119.1	77.3	202	169.4	110.0	262	219.7	142.7
23	19.3	12.5	83	69.6	45.2	143	119.9	77.9	203	170.3	110.6	263	220.6	143.2
24	20.1	13.1	84	70.4	45.7	144	120.8	78.4	204	171.1	111.1	264	221.4	143.8
25	21.0	13.6	85	71.3	46.3	145	121.6	79.0	205	171.9	111.7	265	222.2	144.3
26	21.8	14.2	86	72.1	46.8	146	122.4	79.5	206	172.8	112.2	266	223.1	144.9
27	22.6	14.7	87	73.0	47.4	147	123.3	80.1	207	173.6	112.7	267	223.9	145.4
28	23.5	15.2	88	73.8	47.9	148	124.1	80.6	208	174.4	113.3	268	224.8	146.0
29	24.3	15.8	89	74.6	48.5	149	125.0	81.2	209	175.3	113.8	269	225.6	146.5
30	25.2	16.3	90	75.5	49.0	150	125.8	81.7	210	176.1	114.4	270	226.4	147.1
31	26.0	16.9	91	76.3	49.6	151	126.6	82.2	211	177.0	114.9	271	227.3	147.6
32	26.8	17.4	92	77.2	50.1	152	127.5	82.8	212	177.8	115.5	272	228.1	148.1
33	27.7	18.0	93	78.0	50.7	153	128.3	83.3	213	178.6	116.0	273	229.0	148.7
34	28.5	18.5	94	78.8	51.2	154	129.2	83.9	214	179.5	116.6	274	229.8	149.2
35	29.4	19.1	95	79.7	51.7	155	130.0	84.4	215	180.3	117.1	275	230.6	149.8
36	30.2	19.6	96	80.5	52.3	156	130.8	85.0	216	181.2	117.6	276	231.5	150.3
37	31.0	20.2	97	81.4	52.8	157	131.7	85.5	217	182.0	118.2	277	232.3	150.9
38	31.9	20.7	98	82.2	53.4	158	132.5	86.1	218	182.8	118.7	278	233.2	151.4
39	32.7	21.2	99	83.0	53.9	159	133.3	86.6	219	183.7	119.3	279	234.0	152.0
40	33.5	21.8	100	83.9	54.5	160	134.2	87.1	220	184.5	119.8	280	234.8	152.5
41	34.4	22.3	101	84.7	55.0	161	135.0	87.7	221	185.3	120.4	281	235.7	153.0
42	35.2	22.9	102	85.5	55.6	162	135.9	88.2	222	186.2	120.9	282	236.5	153.6
43	36.1	23.4	103	86.4	56.1	163	136.7	88.8	223	187.0	121.5	283	237.3	154.1
44	36.9	24.0	104	87.2	56.6	164	137.5	89.3	224	187.9	122.0	284	238.2	154.7
45	37.7	24.5	105	88.1	57.2	165	138.4	89.9	225	188.7	122.5	285	239.0	155.2
46	38.6	25.1	106	88.9	57.7	166	139.2	90.4	226	189.5	123.1	286	239.9	155.8
47	39.4	25.6	107	89.7	58.3	167	140.1	91.0	227	190.4	123.6	287	240.7	156.3
48	40.3	26.1	108	90.6	58.8	168	140.9	91.5	228	191.2	124.2	288	241.5	156.9
49	41.1	26.7	109	91.4	59.4	169	141.7	92.0	229	192.1	124.7	289	242.4	157.4
50	41.9	27.2	110	92.3	59.9	170	142.6	92.6	230	192.9	125.3	290	243.2	157.9
51	42.8	27.8	111	93.1	60.5	171	143.4	93.1	231	193.7	125.8	291	244.1	158.5
52	43.6	28.3	112	93.9	61.0	172	144.3	93.7	232	194.6	126.4	292	244.9	159.0
53	44.4	28.9	113	94.8	61.5	173	145.1	94.2	233	195.4	126.9	293	245.7	159.6
54	45.3	29.4	114	95.6	62.1	174	145.9	94.8	234	196.2	127.4	294	246.6	160.1
55	46.1	30.0	115	96.4	62.6	175	146.8	95.3	235	197.1	128.0	295	247.4	160.7
56	47.0	30.5	116	97.3	63.2	176	147.6	95.9	236	197.9	128.5	296	248.2	161.2
57	47.8	31.0	117	98.1	63.7	177	148.4	96.4	237	198.8	129.1	297	249.1	161.8
58	48.6	31.6	118	99.0	64.3	178	149.3	96.9	238	199.6	129.6	298	249.9	162.3
59	49.5	32.1	119	99.8	64.8	179	150.1	97.5	239	200.4	130.2	299	250.8	162.8
60	50.3	32.7	120	100.6	65.4	180	151.0	98.0	240	201.3	130.7	300	251.6	163.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 57 Degrees.

TABLE II.

Difference of Latitude and Departure for 34 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	50.6	34.1	121	100.3	67.7	181	150.1	101.2	241	199.8	134.8
2	01.7	01.1	62	51.4	34.7	122	101.1	68.2	182	150.9	101.8	242	200.6	135.3
3	02.5	01.7	63	52.2	35.2	123	102.0	68.8	183	151.7	102.3	243	201.5	135.9
4	03.3	02.2	64	53.1	35.8	124	102.8	69.3	184	152.5	102.9	244	202.3	136.4
5	04.1	02.8	65	53.9	36.3	125	103.6	69.9	185	153.4	103.5	245	203.1	137.0
6	05.0	03.4	66	54.7	36.9	126	104.5	70.5	186	154.2	104.0	246	203.9	137.6
7	05.8	03.9	67	55.5	37.5	127	105.3	71.0	187	155.0	104.6	247	204.8	138.1
8	06.6	04.5	68	56.4	38.0	128	106.1	71.6	188	155.9	105.1	248	205.6	138.7
9	07.5	05.0	69	57.2	38.6	129	106.9	72.1	189	156.7	105.7	249	206.4	139.2
10	08.3	05.6	70	58.0	39.1	130	107.8	72.7	190	157.5	106.2	250	207.3	139.8
11	09.1	06.2	71	58.9	39.7	131	108.6	73.3	191	158.3	106.8	251	208.1	140.4
12	09.9	06.7	72	59.7	40.3	132	109.4	73.8	192	159.2	107.4	252	208.9	140.9
13	10.8	07.3	73	60.5	40.8	133	110.3	74.4	193	160.0	107.9	253	209.7	141.5
14	11.6	07.8	74	61.3	41.4	134	111.1	74.9	194	160.8	108.5	254	210.6	142.0
15	12.4	08.4	75	62.2	41.9	135	111.9	75.5	195	161.7	109.0	255	211.4	142.6
16	13.3	08.9	76	63.0	42.5	136	112.7	76.1	196	162.5	109.6	256	212.2	143.2
17	14.1	09.5	77	63.8	43.1	137	113.6	76.6	197	163.3	110.2	257	213.1	143.7
18	14.9	10.1	78	64.7	43.6	138	114.4	77.2	198	164.1	110.7	258	213.9	144.3
19	15.8	10.6	79	65.5	44.2	139	115.2	77.7	199	165.0	111.3	259	214.7	144.8
20	16.6	11.2	80	66.3	44.7	140	116.1	78.3	200	165.8	111.8	260	215.5	145.4
21	17.4	11.7	81	67.2	45.3	141	116.9	78.8	201	166.6	112.4	261	216.4	145.9
22	18.2	12.3	82	68.0	45.9	142	117.7	79.4	202	167.5	113.0	262	217.2	146.5
23	19.1	12.9	83	68.8	46.4	143	118.6	80.0	203	168.3	113.5	263	218.0	147.1
24	19.9	13.4	84	69.6	47.0	144	119.4	80.5	204	169.1	114.1	264	218.9	147.6
25	20.7	14.0	85	70.5	47.5	145	120.2	81.1	205	170.0	114.6	265	219.7	148.2
26	21.6	14.5	86	71.3	48.1	146	121.0	81.6	206	170.8	115.2	266	220.5	148.7
27	22.4	15.1	87	72.1	48.6	147	121.9	82.2	207	171.6	115.8	267	221.4	149.3
28	23.2	15.7	88	73.0	49.2	148	122.7	82.8	208	172.4	116.3	268	222.2	149.9
29	24.0	16.2	89	73.8	49.8	149	123.5	83.3	209	173.3	116.9	269	223.0	150.4
30	24.9	16.8	90	74.6	50.3	150	124.4	83.9	210	174.1	117.4	270	223.8	151.0
31	25.7	17.3	91	75.4	50.9	151	125.2	84.4	211	174.9	118.0	271	224.7	151.5
32	26.5	17.9	92	76.3	51.4	152	126.0	85.0	212	175.8	118.5	272	225.5	152.1
33	27.4	18.5	93	77.1	52.0	153	126.8	85.6	213	176.6	119.1	273	226.3	152.7
34	28.2	19.0	94	77.9	52.6	154	127.7	86.1	214	177.4	119.7	274	227.2	153.2
35	29.0	19.6	95	78.8	53.1	155	128.5	86.7	215	178.2	120.2	275	228.0	153.8
36	29.8	20.1	96	79.6	53.7	156	129.3	87.2	216	179.1	120.8	276	228.8	154.3
37	30.7	20.7	97	80.4	54.2	157	130.2	87.8	217	179.9	121.3	277	229.6	154.9
38	31.5	21.2	98	81.2	54.8	158	131.0	88.4	218	180.7	121.9	278	230.5	155.5
39	32.3	21.8	99	82.1	55.4	159	131.8	88.9	219	181.6	122.5	279	231.3	156.0
40	33.2	22.4	100	82.9	55.9	160	132.6	89.5	220	182.4	123.0	280	232.1	156.6
41	34.0	22.9	101	83.7	56.5	161	133.5	90.0	221	183.2	123.6	281	233.0	157.1
42	34.8	23.5	102	84.6	57.0	162	134.3	90.6	222	184.0	124.1	282	233.8	157.7
43	35.6	24.0	103	85.4	57.6	163	135.1	91.1	223	184.9	124.7	283	234.6	158.3
44	36.5	24.6	104	86.2	58.2	164	136.0	91.7	224	185.7	125.3	284	235.4	158.8
45	37.3	25.2	105	87.0	58.7	165	136.8	92.3	225	186.5	125.8	285	236.3	159.4
46	38.1	25.7	106	87.9	59.3	166	137.6	92.8	226	187.4	126.4	286	237.1	159.9
47	39.0	26.3	107	88.7	59.8	167	138.4	93.4	227	188.2	126.9	287	237.9	160.5
48	39.8	26.8	108	89.5	60.4	168	139.3	93.9	228	189.0	127.5	288	238.8	161.0
49	40.6	27.4	109	90.4	61.0	169	140.1	94.5	229	189.8	128.1	289	239.6	161.6
50	41.5	28.0	110	91.2	61.5	170	140.9	95.1	230	190.7	128.6	290	240.4	162.2
51	42.3	28.5	111	92.0	62.1	171	141.8	95.6	231	191.5	129.2	291	241.2	162.7
52	43.1	29.1	112	92.9	62.6	172	142.6	96.2	232	192.3	129.7	292	242.1	163.3
53	43.9	29.6	113	93.7	63.2	173	143.4	96.7	233	193.2	130.3	293	242.9	163.8
54	44.8	30.2	114	94.5	63.7	174	144.3	97.3	234	194.0	130.9	294	243.7	164.4
55	45.6	30.8	115	95.3	64.3	175	145.1	97.9	235	194.8	131.4	295	244.6	165.0
56	46.4	31.3	116	96.2	64.9	176	145.9	98.4	236	195.7	132.0	296	245.4	165.5
57	47.3	31.9	117	97.0	65.4	177	146.7	99.0	237	196.5	132.5	297	246.2	166.1
58	48.1	32.4	118	97.8	66.0	178	147.6	99.5	238	197.3	133.1	298	247.1	166.6
59	48.9	33.0	119	98.7	66.5	179	148.4	100.1	239	198.1	133.6	299	247.9	167 2
60	49.7	33.6	120	99.5	67.1	180	149.2	100.7	240	199.0	134.2	300	248.7	167.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 56 Degrees.

TABLE II.

Difference of Latitude and Departure for 35 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	50.0	35.0	121	99.1	69.4	181	148.3	103.8	241	197.4	138.2
2	01.6	01.1	62	50.8	35.6	122	99.9	70.0	182	149.1	104.4	242	198.2	138.8
3	02.5	01.7	63	51.6	36.1	123	100.8	70.5	183	149.9	105.0	243	199.1	139.4
4	03.3	02.3	64	52.4	36.7	124	101.6	71.1	184	150.7	105.5	244	199.9	140.0
5	04.1	02.9	65	53.2	37.3	125	102.4	71.7	185	151.5	106.1	245	200.7	140.5
6	04.9	03.4	66	54.1	37.9	126	103.2	72.3	186	152.4	106.7	246	201.5	141.1
7	05.7	04.0	67	54.9	38.4	127	104.0	72.8	187	153.2	107.3	247	202.3	141.7
8	06.6	04.6	68	55.7	39.0	128	104.9	73.4	188	154.0	107.8	248	203.1	142.2
9	07.4	05.2	69	56.5	39.6	129	105.7	74.0	189	154.8	108.4	249	204.0	142.8
10	08.2	05.7	70	57.3	40.2	130	106.5	74.6	190	155.6	109.0	250	204.8	143.4
11	09.0	06.3	71	58.2	40.7	131	107.3	75.1	191	156.5	109.6	251	205.6	144.0
12	09.8	06.9	72	59.0	41.3	132	108.1	75.7	192	157.3	110.1	252	206.4	144.5
13	10.6	07.5	73	59.8	41.9	133	108.9	76.3	193	158.1	110.7	253	207.2	145.1
14	11.5	08.0	74	60.6	42.4	134	109.8	76.9	194	158.9	111.3	254	208.1	145.7
15	12.3	08.6	75	61.4	43.0	135	110.6	77.4	195	159.7	111.8	255	208.9	146.3
16	13.1	09.2	76	62.3	43.6	136	111.4	78.0	196	160.6	112.4	256	209.7	146.8
17	13.9	09.8	77	63.1	44.2	137	112.2	78.6	197	161.4	113.0	257	210.5	147.4
18	14.7	10.3	78	63.9	44.7	138	113.0	79.2	198	162.2	113.6	258	211.3	148.0
19	15.6	10.9	79	64.7	45.3	139	113.9	79.7	199	163.0	114.1	259	212.2	148.6
20	16.4	11.5	80	65.5	45.9	140	114.7	80.3	200	163.8	114.7	260	213.0	149.1
21	17.2	12.0	81	66.4	46.5	141	115.5	80.9	201	164.6	115.3	261	213.8	149.7
22	18.0	12.6	82	67.2	47.0	142	116.3	81.4	202	165.5	115.9	262	214.6	150.3
23	18.8	13.2	83	68.0	47.6	143	117.1	82.0	203	166.3	116.4	263	215.4	150.9
24	19.7	13.8	84	68.8	48.2	144	118.0	82.6	204	167.1	117.0	264	216.3	151.4
25	20.5	14.3	85	69.6	48.8	145	118.8	83.2	205	167.9	117.6	265	217.1	152.0
26	21.3	14.9	86	70.4	49.3	146	119.6	83.7	206	168.7	118.2	266	217.9	152.6
27	22.1	15.5	87	71.3	49.9	147	120.4	84.3	207	169.6	118.7	267	218.7	153.1
28	22.9	16.1	88	72.1	50.5	148	121.2	84.9	208	170.4	119.3	268	219.5	153.7
29	23.8	16.6	89	72.9	51.0	149	122.1	85.5	209	171.2	119.9	269	220.4	154.3
30	24.6	17.2	90	73.7	51.6	150	122.9	86.0	210	172.0	120.5	270	221.2	154.9
31	25.4	17.8	91	74.5	52.2	151	123.7	86.6	211	172.8	121.0	271	222.0	155.4
32	26.2	18.4	92	75.4	52.8	152	124.5	87.2	212	173.7	121.6	272	222.8	156.0
33	27.0	18.9	93	76.2	53.3	153	125.3	87.8	213	174.5	122.2	273	223.6	156.6
34	27.9	19.5	94	77.0	53.9	154	126.1	88.3	214	175.3	122.7	274	224.4	157.2
35	28.7	20.1	95	77.8	54.5	155	127.0	88.9	215	176.1	123.3	275	225.3	157.7
36	29.5	20.6	96	78.6	55.1	156	127.8	89.5	216	176.9	123.9	276	226.1	158.3
37	30.3	21.2	97	79.5	55.6	157	128.6	90.1	217	177.8	124.5	277	226.9	158.9
38	31.1	21.8	98	80.3	56.2	158	129.4	90.6	218	178.6	125.0	278	227.7	159.5
39	31.9	22.4	99	81.1	56.8	159	130.2	91.2	219	179.4	125.6	279	228.5	160.0
40	32.8	22.9	100	81.9	57.4	160	131.1	91.8	220	180.2	126.2	280	229.4	160.6
41	33.6	23.5	101	82.7	57.9	161	131.9	92.3	221	181.0	126.8	281	230.2	161.2
42	34.4	24.1	102	83.6	58.5	162	132.7	92.9	222	181.9	127.3	282	231.0	161.7
43	35.2	24.7	103	84.4	59.1	163	133.5	93.5	223	182.7	127.9	283	231.8	162.3
44	36.0	25.2	104	85.2	59.7	164	134.3	94.1	224	183.5	128.5	284	232.6	162.9
45	36.9	25.8	105	86.0	60.2	165	135.2	94.6	225	184.3	129.1	285	233.5	163.5
46	37.7	26.4	106	86.8	60.8	166	136.0	95.2	226	185.1	129.6	286	234.3	164.0
47	38.5	27.0	107	87.6	61.4	167	136.8	95.8	227	185.9	130.2	287	235.1	164.6
48	39.3	27.5	108	88.5	61.9	168	137.6	96.4	228	186.8	130.8	288	235.9	165.2
49	40.1	28.1	109	89.3	62.5	169	138.4	96.9	229	187.6	131.3	289	236.7	165.8
50	41.0	28.7	110	90.1	63.1	170	139.3	97.5	230	188.4	131.9	290	237.6	166.3
51	41.8	29.3	111	90.9	63.7	171	140.1	98.1	231	189.2	132.5	291	238.4	166.9
52	42.6	29.8	112	91.7	64.2	172	140·9	98.7	232	190.0	133.1	292	239.2	167.5
53	43.4	30.4	113	92.6	64.8	173	141.7	99.2	233	190.9	133.6	293	240.0	168.1
54	44.2	31.0	114	93.4	65.4	174	142.5	99.8	234	191.7	134.2	294	240.8	168.6
55	45.1	31.5	115	94.2	66.0	175	143.4	100.4	235	192.5	134.8	295	241.6	169.2
56	45.9	32.1	116	95.0	66.5	176	144.2	100.9	236	193.3	135.4	296	242.5	169.8
57	46.7	32.7	117	95.8	67.1	177	145.0	101.5	237	194.1	135.9	297	243.3	170.4
58	47.5	33.3	118	96.7	67.7	178	145.8	102.1	238	195.0	136.5	298	244.1	170.9
59	48.3	33.8	119	97.5	68.3	179	146.6	102.7	239	195.8	137.1	299	244.9	171.5
60	49.1	34.4	120	98.3	68.8	180	147.4	103.2	240	196.6	137.7	300	245.7	172.1
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 55 Degrees.

TABLE II.

Difference of Latitude and Departure for 36 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	49.4	35.9	121	97.9	71.1	181	146.4	106.4	241	195.0	141.7
2	01.6	01.2	62	50.2	36.4	122	98.7	71.7	182	147.2	107.0	242	195.8	142.2
3	02.4	01.8	63	51.0	37.0	123	99.5	72.3	183	148.1	107.6	243	196.6	142.8
4	03.2	02.4	64	51.8	37.6	124	100.3	72.9	184	148.9	108.2	244	197.4	143.4
5	04.0	02.9	65	52.6	38.2	125	101.1	73.5	185	149.7	108.7	245	198.2	144.0
6	04.9	03.5	66	53.4	38.8	126	101.9	74.1	186	150.5	109.3	246	199.0	144.6
7	05.7	04.1	67	54.2	39.4	127	102.7	74.6	187	151.3	109.9	247	199.8	145.2
8	06.5	04.7	68	55.0	40.0	128	103.6	75.2	188	152.1	110.5	248	200.6	145.8
9	07.3	05.3	69	55.8	40.6	129	104.4	75.8	189	152.9	111.1	249	201.4	146.4
10	08.1	05.9	70	56.6	41.1	130	105.2	76.4	190	153.7	111.7	250	202.3	146.9
11	08.9	06.5	71	57.4	41.7	131	106.0	77.0	191	154.5	112.3	251	203.1	147.5
12	09.7	07.1	72	58.2	42.3	132	106.8	77.6	192	155.3	112.9	252	203.9	148.1
13	10.5	07.6	73	59.1	42.9	133	107.6	78.2	193	156.1	113.4	253	204.7	148.7
14	11.3	08.2	74	59.9	43.5	134	108.4	78.8	194	156.9	114.0	254	205.5	149 3
15	12.1	08.8	75	60.7	44.1	135	109.2	79.4	195	157 8	114.6	255	206.3	149.9
16	12.9	09.4	76	61.5	44.7	136	110.0	79.9	196	158.6	115.2	256	207.1	150.5
17	13.8	10.0	77	62.3	45.3	137	110.8	80.5	197	159.4	115.8	257	207.9	151.1
18	14.6	10.6	78	63.1	45.8	138	111.6	81.1	108	160.2	116.4	258	208.7	151.6
19	15.4	11.2	79	63.9	46.4	139	112.5	81.7	199	161.0	117.0	259	209.5	152.2
20	16.2	11.8	80	64.7	47.0	140	113.3	82.3	200	161.8	117.6	260	210.3	152.8
21	17.0	12.3	81	65.5	47.6	141	114.1	82.9	201	162.6	118.1	261	211.2	153.4
22	17.8	12.9	82	66.3	48.2	142	114.9	83.5	202	163.4	118.7	262	212.0	154.0
23	18.6	13.5	83	67.1	48.8	143	115.7	84.1	203	164.2	119.3	263	212.8	154.6
24	19.4	14.1	84	68.0	49.4	144	116.5	84.6	204	165.0	119.9	264	213.6	155.2
25	20.2	14.7	85	68.8	50.0	145	117.3	85.2	205	165.8	120.5	265	214.4	155.8
26	21.0	15.3	86	69.6	50.5	146	118.1	85.8	206	166.7	121.1	266	215.2	156.4
27	22.8	15.9	87	70.4	51.1	147	118.9	86.4	207	167.5	121.7	267	216.0	156.9
28	22.7	16.5	88	71.2	51.7	148	119.7	87.0	208	168.3	122.3	268	216.8	157.5
29	23.5	17.0	89	72.0	52.3	149	120.5	87.6	209	169.1	122.8	269	217.6	158.1
30	24.3	17.6	90	72.8	52.9	150	121.4	88.2	210	169.9	123.4	270	218.4	158.7
31	25.1	18.2	91	73.6	53.5	151	122.2	88.8	211	170.7	124.0	271	219.2	159.3
32	25.9	18.8	92	74.4	54.1	152	123.0	89.3	212	171.5	124.6	272	220.1	159.9
33	26.7	19.4	93	75.2	54.7	153	123.8	89.9	213	172.3	125.2	273	220.9	160.5
34	27.5	20.0	94	76.0	55.3	154	124.6	90.5	214	173.1	125.8	274	221.7	161.1
35	28.3	20.6	95	76.9	55.8	155	125.4	91.1	215	173.9	126.4	275	222.5	161.6
36	29.1	21.2	96	77.7	56.4	156	126.2	91.7	216	174.7	127.0	276	223.3	162.2
37	29.9	21.7	97	78.5	57.0	157	127.0	92.3	217	175.6	127.5	277	224.1	162.8
38	30.7	22.3	98	79.3	57.6	158	127.8	92.9	218	176.4	128.1	278	224.9	163.4
39	31.6	22.9	99	80.1	58.2	159	128.6	93.5	219	177.2	128.7	279	225.7	164.0
40	32.4	23.5	100	80.9	58.8	160	129.4	94.0	220	178.0	129.3	280	226.5	164.6
41	33.2	24.1	101	81.7	59.4	161	130.3	94.6	221	178.8	129.9	281	227.3	165.2
42	34.0	24.7	102	82.5	60.0	162	131.1	95.2	222	179.6	130.5	282	228.1	165.8
43	34.8	25.3	103	83.3	60.5	163	131.9	95.8	223	180.4	131.1	283	229.0	166.3
44	35.6	25.9	104	84.1	61.1	164	132.7	96.4	224	181.2	131.7	284	229.8	166.9
45	36.4	26.5	105	84.9	61.7	165	133.5	97.0	225	182.0	132.3	285	230.6	167.5
46	37.2	27.0	106	85.8	62.3	166	134.3	97.6	226	182.8	132.8	286	231.4	168.1
47	38.0	27.6	107	86.6	62.9	167	135.1	98.2	227	183.6	133.4	287	232.2	168.7
48	38.8	28.2	108	87.4	63.5	168	135.9	98.7	228	184.5	134.0	288	233.0	169.3
49	39.6	28.8	109	88.2	64.1	169	136.7	99.3	229	185.3	134.6	289	233.8	169.9
50	40.5	29.4	110	89.0	64.7	170	137.5	99.9	230	186.1	135.2	290	234 6	170.5
51	41.3	30.0	111	89.8	65.2	171	138.3	100.5	231	186.9	135.8	291	235.4	171.0
52	42.1	30.6	112	90.6	65.8	172	139.2	101.1	232	187.7	136.4	292	236.2	171.6
53	42.9	31.2	113	91.4	66.4	173	140.0	101.7	233	188.5	137.0	293	237.0	172.2
54	43.7	31.7	114	92.2	67.0	174	140.8	102.3	234	189.3	137.5	294	237.9	172.8
55	44.5	32.3	115	93.0	67.6	175	141.6	102.9	235	190.1	138.1	295	238.7	173.4
56	45.3	32.9	116	93.8	68.2	176	142.4	103.5	236	190.9	138.7	296	239.5	174.0
57	46.1	33.5	117	94.7	68.8	177	143 2	104.0	237	191.7	139.3	297	240.3	174.6
58	46.9	34.1	118	95.5	69.4	178	144.0	104.6	238	192.5	139.9	298	241.1	175.2
59	47.7	34 7	119	96.3	69.9	179	144.8	105.2	239	193.4	140.5	299	241.9	175.7
60	48.5	35.3	120	97.1	70.5	180	145.6	105.8	240	194.2	141.1	300	242.7	176.3
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 54 Degrees.

TABLE II.

Difference of Latitude and Departure for 37 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	48.7	36.7	121	96.6	72.8	181	144.6	108.9	241	192.5	145.0
2	01.6	01.2	62	49.5	37.3	122	97.4	73.4	182	145.4	109.5	242	193.3	145.6
3	02.4	01.8	63	50.3	37.9	123	98.2	74.0	183	146.2	110.1	243	194.1	146.2
4	03.2	02.4	64	51.1	38.5	124	99.0	74.6	184	146.9	110.7	244	194.9	146.8
5	04.0	03.0	65	51.9	39.1	125	99.8	75.2	185	147.7	111.3	245	195.7	147.4
6	04.8	03.6	66	52.7	39.7	126	100.6	75.8	186	148.5	111.9	246	196.5	148.0
7	05.6	04.2	67	53.5	40.3	127	101.4	76.4	187	149.3	112.5	247	197.3	148.6
8	06.4	04.8	68	54.3	40.9	128	102.2	77 0	188	150.1	113.1	248	198.1	149.3
9	07.2	05.4	69	55.1	41.5	129	103.0	77.6	189	150.9	113.7	249	198.9	149.9
10	08.0	06.0	70	55.9	42.1	130	103.8	78.2	190	151.7	114.3	250	199.7	150.5
11	08.8	06.6	71	56.7	42.7	131	104.6	78.8	191	152.5	114.9	251	200.5	151.1
12	09.6	07.2	72	57.5	43.3	132	105.4	79.4	192	153.3	115.5	252	201.3	151.7
13	10.4	07.8	73	58.3	43.9	133	106.2	80.0	193	154.1	116.2	253	202.1	152.3
14	11.2	08.4	74	59.1	44.5	134	107.0	80.6	194	154.9	116.8	254	202.9	152.9
15	12.0	09.0	75	59.9	45.1	135	107.8	81.2	195	155.7	117.4	255	203.7	153.5
16	12.8	09.6	76	60.7	45.7	136	108.6	81.8	196	156.5	118.0	256	204.5	154.1
17	13.6	10.2	77	61.5	46.3	137	109.4	82.4	197	157.3	118.6	257	205.2	154.7
18	14.4	10.8	78	62.3	46.9	138	110.2	83.1	198	158.1	119.2	258	206.0	155.3
19	15.2	11.4	79	63.1	47.5	139	111.0	83.7	199	158.9	119.8	259	206.8	155.9
20	16.0	12.0	80	63.9	48.1	140	111.8	84.3	200	159.7	120.4	260	207.6	156.5
21	16.8	12.6	81	64.7	48.7	141	112.6	84.9	201	160.5	121.0	261	208.4	157.1
22	17.6	13.2	82	65.5	49.3	142	113.4	85.5	202	161.3	121.6	262	209.2	157.7
23	18.4	13.8	83	66.3	50.0	143	114.2	86.1	203	162.1	122.2	263	210.0	158.3
24	19.2	14.4	84	67.1	50.6	144	115.0	86.7	204	162.9	122.8	264	210.8	158.9
25	20.0	15.0	85	67.9	51.2	145	115.8	87.3	205	163.7	123.4	265	211.6	159.5
26	20.8	15.6	86	68.7	51.8	146	116.6	87.9	206	164.5	124.0	266	212.4	160.1
27	21.6	16.2	87	69.5	52.4	147	117.4	88.5	207	165.3	124.6	267	213.2	160.7
28	22.4	16.9	88	70.3	53.0	148	118.2	89.1	208	166.1	125.2	268	214.0	161.3
29	23.2	17.5	89	71.1	53.6	149	119.0	89.7	209	166.9	125.8	269	214.8	161.9
30	24.0	18.1	90	71.9	54.2	150	119.8	90.3	210	167.7	126.4	270	215.6	162.5
31	24.8	18.7	91	72.7	54.8	151	120.6	90.9	211	168.5	127.0	271	216.4	163.1
32	25.6	19.3	92	73.5	55.4	152	121.4	91.5	212	169.3	127.6	272	217.2	163.7
33	26.4	19.9	93	74.3	56.0	153	122.2	92.1	213	170.1	128.2	273	218.0	164.3
34	27.2	20.5	94	75.1	56.6	154	123.0	92.7	214	170.9	128.8	274	218.8	164.9
35	28.0	21.1	95	75.9	57.2	155	123.8	93.3	215	171.7	129.4	275	219.6	165.5
36	28.8	21.7	96	76.7	57.8	156	124.6	93.9	216	172.5	130.0	276	220.4	166.1
37	29.5	22.3	97	77.5	58.4	157	125.4	94.5	217	173.3	130.6	277	221.2	166.7
38	30.3	22.9	98	78.3	59.0	158	126.2	95.1	218	174.1	131.2	278	222.0	167.3
39	31.1	23.5	99	79.1	59.6	159	127.0	95.7	219	174.9	131.8	279	222.8	167.9
40	31.9	24.1	100	79.9	60.2	160	127.8	96.3	220	175.7	132.4	280	223.6	168.5
41	32.7	24.7	101	80.7	60.8	161	128.6	96.9	221	176.5	133.0	281	224.4	169.1
42	33.5	25.3	102	81.5	61.4	162	129.4	97.5	222	177.3	133.6	282	225.2	169.7
43	34.3	25.9	103	82.3	62.0	163	130.2	98.1	223	178.1	134.2	283	226.0	170 3
44	35.1	26.5	104	83.1	62.6	164	131.0	98.7	224	178.9	134.8	284	226.8	170.9
45	35.9	27.1	105	83.9	63.2	165	131.8	99.3	225	179.7	135.4	285	227.6	171.5
46	36.7	27.7	106	84.7	63.8	166	132.6	99.9	226	180.5	136.0	286	228.4	172.1
47	37.5	28.3	107	85.5	64.4	167	133.4	100.5	227	181.3	136.6	287	229.2	172.7
48	38.3	28.9	108	86.3	65.0	168	134.2	101.1	228	182.1	137.2	288	230.0	173.3
49	39.1	29.5	109	87.1	65.6	169	135.0	101.7	229	182.9	137.8	289	230.8	173.7
50	39.9	30.1	110	87.8	66.2	170	135.8	102.3	230	183.7	138.4	290	231.6	174.5
51	40.7	30.7	111	88.6	66.8	171	136.6	102.9	231	184.5	139.0	291	232.4	175.1
52	41.5	31.3	112	89.4	67.4	172	137.4	103.5	232	185.3	139.6	292	233.2	175.7
53	42.3	31.9	113	90.2	68.0	173	138.2	104.1	233	186.1	140.2	293	234.0	176.3
54	43.1	32.5	114	91.0	68.6	174	139.0	104.7	234	186.9	140.8	294	234.8	176.9
55	43.9	33.1	115	91.8	69.2	175	139.8	105.3	235	187.7	141.4	295	235.6	177.5
56	44.7	33.7	116	92.6	69.8	176	140.6	105.9	236	188.5	142.0	296	236.4	178.1
57	45.5	34.3	117	93.4	70.4	177	141.4	106.5	237	189.3	142.6	297	237.2	178.7
58	46.3	34.9	118	94.2	71.0	178	142.2	107.1	238	190.1	143.2	298	238.0	179.3
59	47.1	35.5	119	95.0	71.6	179	143.0	107.7	239	190.9	143.3	299	238.8	179.9
60	47.9	36.1	120	95.8	72.2	180	143.8	108.3	240	191.7	144.4	300	239.6	180.5
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist.	Dep.	Lat.

For 53 Degrees.

TABLE II.

Difference of Latitude and Departure for 38 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	48.1	37.6	121	95.3	74.5	181	142.6	111.4	241	189.9	148.4
2	01.6	01.2	62	48.9	38.2	122	96.1	75.1	182	143.4	112.1	242	190.7	149.0
3	02.4	01.8	63	49.6	38.8	123	96.9	75.7	183	144.2	112.7	243	191.5	149.6
4	03.2	02.5	64	50.4	39.4	124	97.7	76.3	184	145.0	113.3	244	192.3	150.2
5	03.9	03.1	65	51.2	40.0	125	98.5	77.0	185	145.8	113.9	245	193.1	150.8
6	04.7	03.7	66	52.0	40.6	126	99.3	77.6	186	146.6	114.5	246	193.9	151.5
7	05.5	04.3	67	52.8	41.2	127	100.1	78.2	187	147.4	115.1	247	194.6	152.1
8	06.3	04.9	68	53.6	41.9	128	100.9	78.8	188	148.1	115.7	248	195.4	152.7
9	07.1	05.5	69	54.4	42.5	129	101.7	79.4	189	148.9	116.4	249	196.2	153.3
10	07.9	06.2	70	55.2	43.1	130	102.4	80.0	190	149.7	117.0	250	197.0	153.9
11	08.7	06.8	71	55.9	43.7	131	103.2	80.7	191	150.5	117.6	251	197.8	154.5
12	09.5	07.4	72	56.7	44.3	132	104.0	81.3	192	151.3	118.2	252	198.6	155.1
13	10.2	08.0	73	57.5	44.9	133	104.8	81.9	193	152.1	118.8	253	199.4	155.8
14	11.0	08.6	74	58.3	45.6	134	105.6	82.5	194	152.9	119.4	254	200.2	156.4
15	11.8	09.2	75	59.1	46.2	135	106.4	83.1	195	153.7	120.1	255	200.9	157.0
16	12.6	09.9	76	59.9	46.8	136	107.2	83.7	196	154.5	120.7	256	201.7	157.6
17	13.4	10.5	77	60.7	47.4	137	108.0	84.3	197	155.2	121.3	257	202.5	158.2
18	14.2	11.1	78	61.5	48.0	138	108.7	85.0	198	156.0	121.9	258	203.3	158.8
19	15.0	11.7	79	62.3	48.6	139	109.5	85.6	199	156.8	122.5	259	204.1	159.5
20	15.8	12.3	80	63.0	49.3	140	110.3	86.2	200	157.6	123.1	260	204.9	160.1
21	16.5	12.9	81	63.8	49.9	141	111.1	86.8	201	158.4	123.7	261	205.7	160.7
22	17.3	13.5	82	64.6	50.5	142	111.9	87.4	202	159.2	124.4	262	206.5	161.3
23	18.1	14.2	83	65.4	51.1	143	112.7	88.0	203	160.0	125.0	263	207.2	161.9
24	18.9	14.8	84	66.2	51.7	144	113.5	88.7	204	160.8	125.6	264	208.0	152.5
25	19.7	15.4	85	67.0	52·3	145	114.3	89.3	205	161.5	126.2	265	208.8	163.2
26	20.5	16.0	86	67.8	52.9	146	115.0	89.9	206	162.3	126.8	266	209.6	163.8
27	21.3	16.6	87	68.6	53.6	147	115.8	90.5	207	163.1	127.4	267	210.4	164.4
28	22.1	17.2	88	69.3	54.2	148	116.6	91.1	208	163.9	128.1	268	211.2	165.0
29	22.9	17.9	89	70.1	54.8	149	117.4	91.7	209	164.7	128.7	269	212.0	165.6
30	23.6	18.5	90	70.9	55.4	150	118.2	92.3	210	165.5	129.3	270	212.8	166.2
31	24.4	19.1	91	71.7	56.0	151	119.0	93.0	211	166.3	129.9	271	213.6	166.8
32	25.2	19.7	92	72.5	56.6	152	119.8	93.6	212	167.1	130.5	272	214.3	167.5
33	26.0	20.3	93	73.3	57.3	153	120.6	94.2	213	167.8	131.1	273	215.1	168.1
34	26.8	20.9	94	74.1	57.9	154	121.4	94.8	214	168.6	131.8	274	215.9	168.7
35	27.6	21.5	95	74.9	58.5	155	122.1	95.4	215	169.4	132.4	275	216.7	169.3
36	28.4	22.2	96	75.6	59.1	156	122.9	96.0	216	170.2	133.0	276	217.5	169.9
37	29.2	22.8	97	76.4	59.7	157	123.7	96.7	217	171.0	133.6	277	218.3	170.5
38	29.9	23.4	98	77.2	60.3	158	124.5	97.3	218	171.8	134.2	278	219.1	171.2
39	30.7	24.0	99	78.0	61.0	159	125.3	97.9	219	172.6	134.8	279	219.9	171.8
40	31.5	24.6	100	78.8	61.6	160	126.1	98.5	220	173.4	135.4	280	220.6	172.4
41	32.3	25.2	101	79.6	62.2	161	126.9	99.1	221	174.2	136.1	281	221.4	173.0
42	33.1	25.9	102	80.4	62.8	162	127.7	99.7	222	174.9	136.7	282	222.2	173.6
43	33.9	26.5	103	81.2	63.4	163	128 4	100.4	223	175.7	137.3	283	223.0	174.2
44	34.7	27.1	104	82.0	64.0	164	129.2	101.0	224	176.5	137.9	284	223.8	174.8
45	35.5	27.7	105	82.7	64.6	165	130.0	101.6	225	177.3	138.5	285	224.6	175.5
46	36.2	28.3	106	83.5	65.3	166	130.8	102.2	226	178.1	139.1	286	225.4	176.1
47	37.0	28.9	107	84.3	65.9	167	131.6	102.8	227	178.9	139.8	287	226.2	176.7
48	37.8	29.6	108	85.1	66.5	168	132.4	103.4	228	179.7	140.4	288	226.9	177.3
49	38.6	30.2	109	85.9	67.1	169	133.2	104.0	229	180.5	141.0	289	227.7	177.9
50	39.4	30.8	110	86.7	67.7	170	134.0	104.7	230	181.2	141.6	290	228.5	178.5
51	40.2	31.4	111	87.5	68.3	171	134.7	105.3	231	182.0	142.2	291	229.3	179.2
52	41.0	32.0	112	88.3	69.0	172	135.5	105.9	232	182.8	142.8	292	230.1	179.8
53	41.8	32.6	113	89.0	69.6	173	136.3	106.5	233	183.6	143.4	293	230.9	180.4
54	42.6	33.2	114	89.8	70.2	174	137.1	107.1	234	184.4	144.1	294	231.7	181.0
55	43.3	33.9	115	90.6	70.8	175	137.9	107.7	235	185.2	144.7	295	232.5	181.6
56	44.1	34.5	116	91.4	71.4	176	138·7	108.4	236	186.0	145.3	296	233.3	182.2
57	44.9	35.1	117	92.2	72.0	177	139.5	109.0	237	186.8	145.9	297	234.0	182.9
58	45.7	35.7	118	93.0	72.6	178	140.3	109.6	238	187.5	146.5	298	234.8	183.5
59	46.5	36.3	119	93.8	73.3	179	141.1	110.2	239	188.3	147.1	299	235.6	184.1
60	47.3	36.9	120	94.6	73.9	180	141.8	110.8	240	189.1	147.8	300	236.4	184.7
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 52 Degrees.

TABLE II.

Difference of Latitude and Departure for 39 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	47.4	38.4	121	94.0	76.1	181	140.7	113.9	241	187.3	151.7
2	01.6	01.3	62	48.2	39.0	122	94.8	76.8	182	141.4	114.5	242	188.1	152.3
3	02.3	01.9	63	49.0	39.6	123	95.6	77.4	183	142.2	115.2	243	188.8	152.9
4	03.1	02.5	64	49.7	40.3	124	96.4	78.0	184	143.0	115.8	244	189.6	153.6
5	03.9	03.1	65	50.5	40.9	125	97.1	78.7	185	143.8	116.4	245	190.4	154.2
6	04.7	03.8	66	51.3	41.5	126	97.9	79.3	186	144.5	117.1	246	191.2	154.8
7	05.4	04.4	67	52.1	42.2	127	98.7	79.9	187	145.3	117.7	247	192.0	155.4
8	06.2	05.0	68	52.8	42.8	128	99.5	80.6	188	146.1	118.3	248	192.7	156.1
9	07.0	05.7	69	53.6	43.4	129	100.3	81.2	189	146.9	118.9	249	193.5	156.7
10	07.8	06.3	70	54.4	44.1	130	101.0	81.8	190	147.7	119.6	250	194.3	157.3
11	08.5	06.9	71	55.2	44.7	131	101.8	82.4	191	148.4	120.2	251	195.1	158.0
12	09.3	07.6	72	56.0	45.3	132	102.6	83.1	192	149.2	120.8	252	195.8	158.6
13	10.1	08.2	73	56.7	45.9	133	103.4	83.7	193	150.0	121.5	253	196.6	159.2
14	10.9	08.8	74	57.5	46.6	134	104.1	84.3	194	150.8	122.1	254	197.4	159.8
15	11.7	09.4	75	58.3	47.2	135	104.9	85.0	195	151.5	122.7	255	198.2	160.5
16	12.4	10.1	76	59.1	47.8	136	105.7	85.6	196	152.3	123.3	256	198.9	161.1
17	13.2	10.7	77	59.8	48.5	137	106.5	86.2	197	153.1	124.0	257	199.7	161.7
18	14.0	11.3	78	60.6	49.1	138	107.2	86.8	198	153.9	124.6	258	200.5	162.4
19	14.8	12.0	79	61.4	49.7	139	108.0	87.5	199	154.7	125.2	259	201.3	163.0
20	15.5	12.6	80	62.2	50.3	140	108.8	88.1	200	155.4	125.9	260	202.1	163.6
21	16.3	13.2	81	62.9	51.0	141	109.6	88.7	201	156.2	126.5	261	202.8	164.3
22	17.1	13.8	82	63.7	51.6	142	110.4	89.4	202	157.0	127.1	262	203.6	164.9
23	17.9	14.5	83	64.5	52.2	143	111.1	90.0	203	157.8	127.8	263	204.4	165.5
24	18.7	15.1	84	65.3	52.9	144	111.9	90.6	204	158.5	128.4	264	205.2	166.1
25	19.4	15.7	85	66.1	53.5	145	112.7	91.3	205	159.3	129.0	265	205.9	166.8
26	20.2	16.4	86	66.8	54.1	146	113.5	91.9	206	160.1	129.6	266	206.7	167.4
27	21.0	17.0	87	67.6	54.8	147	114.2	92.5	207	160.9	130.3	267	207.5	168.0
28	21.8	17.6	88	68.4	55.4	148	115.0	93.1	208	161.6	130.9	268	208.3	168.7
29	22.5	18.3	89	69.2	56.0	149	115.8	93.8	209	162.4	131.5	269	209.1	169.3
30	23.3	18.9	90	69.9	56.6	150	116.6	94.4	210	163.2	132.2	270	209.8	169.9
31	24.1	19.5	91	70.7	57.3	151	117.3	95.0	211	164.0	132.8	271	210.6	170.5
32	24.9	20.1	92	71.5	57.9	152	118.1	95.7	212	164.8	133.4	272	211.4	171.2
33	25.6	20.8	93	72.3	58.5	153	118.9	96.3	213	165.5	134.0	273	212.2	171.8
34	26.4	21.4	94	73.1	59.2	154	119.7	96.9	214	166.3	134.7	274	212.9	172.4
35	27.2	22.0	95	73.8	59.8	155	120.5	97.5	215	167.1	135.3	275	213.7	173.1
36	28.0	22.7	96	74.6	60.4	156	121.2	98.2	216	167.9	135.9	276	214.5	173.7
37	28.8	23.3	97	75.4	61.0	157	122.0	98.8	217	168.6	136.6	277	215.3	174.3
38	29.5	23.9	98	76.2	61.7	158	122.8	99.4	218	169.4	137.2	278	216.0	175.0
39	30.3	24.5	99	76.9	62.3	159	123.6	100.1	219	170.2	137.8	279	216.8	175.6
40	31.1	25.2	100	77.7	62.9	160	124.3	100.7	220	171.0	138.5	280	217.6	176.2
41	31.9	25.8	101	78.5	63.6	161	125.1	101.3	221	171.7	139.1	281	218.4	176.8
42	32.6	26.4	102	79.3	64.2	162	125.9	101.9	222	172.5	139.7	282	219.2	177.5
43	33.4	27.1	103	80.0	64.8	163	126.7	102.6	223	173.3	140.3	283	219.9	178.1
44	34.2	27.7	104	80.8	65.4	164	127.5	103.2	224	174.1	141.0	284	220.7	178.7
45	35.0	28.3	105	81.6	66.1	165	128.2	103.8	225	174.9	141.6	285	221.5	179.4
46	35.7	28.9	106	82.4	66.7	166	129.0	104.5	226	175.6	142.2	286	222.3	180.0
47	36.5	29.6	107	83.2	67.3	167	129.8	105.1	227	176.4	142.9	287	223.0	180.6
48	37.3	30.2	108	83.9	68.0	168	130.6	105.7	228	177.2	143.5	288	223.8	181.2
49	38.1	30.8	109	84.7	68.6	169	131.3	106.4	229	178.0	144.1	289	224.6	181.9
50	38.9	31.5	110	85.5	69.2	170	132.1	107.0	230	178.7	144.7	290	225.4	182.5
51	39.6	32.1	111	86.3	69.9	171	132.9	107.6	231	179.5	145.4	291	226.1	183.1
52	40.4	32.7	112	87.0	70.5	172	133.7	108.2	232	180.3	146.0	292	226.9	183.8
53	41.2	33.4	113	87.8	71.1	173	134.4	108.9	233	181.1	146.6	293	227.7	184.4
54	42.0	34.0	114	88.6	71.7	174	135.2	109.5	234	181.9	147.3	294	228.5	185.0
55	42.7	34.6	115	89.4	72.4	175	136.0	110.1	235	182.6	147.9	295	229.3	185.6
56	43.5	35.2	116	90.1	73.0	176	136.8	110.8	236	183.4	148.5	296	230.0	186.3
57	44.3	35.9	117	90.9	73.6	177	137.6	111.4	237	184.2	149.1	297	230.8	186.9
58	45.1	36.5	118	91.7	74.3	178	138.3	112.0	238	185.0	149.8	298	231.6	187.5
59	45.9	37.1	119	92.5	74.9	179	139.1	112.6	239	185.7	150.4	299	232.4	188.2
60	46.6	37.8	120	93.3	75.5	180	139.9	113.3	240	186.5	151.0	300	233.1	188.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 51 Degrees.

TABLE II.

Difference of Latitude and Departure for 40 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.6	61	46.7	39.2	121	92.7	77.8	181	138.7	116.3	241	184.6	154.9
2	01.5	01.3	62	47.5	39.9	122	93.5	78.4	182	139.4	117.0	242	185.4	155.6
3	02.3	01.9	63	48.3	40.5	123	94.2	79.1	183	140.2	117.6	243	186.1	156.2
4	03.1	02.6	64	49.0	41.1	124	95.0	79.7	184	141.0	118.3	244	186.9	156.8
5	03.8	03.2	65	49.8	41.8	125	95.8	80.3	185	141.7	118.9	245	187.7	157.5
6	04.6	03.9	66	50.6	42.4	126	96.5	81.0	186	142.5	119.6	246	188.4	158.1
7	05.4	04.5	67	51.3	43.1	127	97.3	81.6	187	143.3	120.2	247	189.2	158.8
8	06.1	05.1	68	52.1	43.7	128	98.1	82.3	188	144.0	120.8	248	190.0	159.4
9	06.9	05.8	69	52.9	44.4	129	98.8	82.9	189	144.8	121.5	249	190.7	160.1
10	07.7	06.4	70	53.6	45.0	130	99.6	83.6	190	145.5	122.1	250	191.5	160.7
11	08.4	07.1	71	54.4	45.6	131	100.4	84.2	191	146.3	122.8	251	192.3	161.3
12	09.2	07.7	72	55.2	46.3	132	101.1	84.8	192	147.1	123.4	252	193.0	162.0
13	10.0	08.4	73	55.9	46.9	133	101.9	85.5	193	147.8	124.1	253	193.8	162.6
14	10.7	09.0	74	56.7	47.6	134	102.6	86.1	194	148.6	124.7	254	194.6	163.3
15	11.5	09.6	75	57.5	48.2	135	103.4	86.8	195	149.4	125.3	255	195.3	163.9
16	12.3	10.3	76	58.2	48.9	136	104.2	87.4	196	150.1	126.0	256	196.1	164.6
17	13.0	10.9	77	59.0	49.5	137	104.9	88.1	197	150.9	126.6	257	196.9	165.2
18	13.8	11.6	78	59.8	50.1	138	105.7	88.7	198	151.7	127.3	258	197.6	165.8
19	14.6	12.2	79	60.5	50.8	139	106.5	89.3	199	152.4	127.9	259	198.4	166.5
20	15.3	12.9	80	61.3	51.4	140	107.2	90.0	200	153.2	128.6	260	199.2	167.1
21	16.1	13.5	81	62.0	52.1	141	108.0	90.6	201	154.0	129.2	261	199.9	167.8
22	16.9	14.1	82	62.8	52.7	142	108.8	91.3	202	154.7	129.8	262	200.7	168.4
23	17.6	14.8	83	63.6	53.4	143	109.5	91.9	203	155.5	130.5	263	201.5	169.1
24	18.4	15.4	84	64.3	54.0	144	110.3	92.6	204	156.3	131.1	264	202.2	169.7
25	19.2	16.1	85	65.1	54.6	145	111.1	93.2	205	157.0	131.8	265	203.0	170.3
26	19.9	16.7	86	65.9	55.3	146	111.8	93.8	206	157.8	132.4	266	203.8	171.0
27	20.7	17.4	87	66.6	55.9	147	112.6	94.5	207	158.6	133.1	267	204.5	171.6
28	21.4	18.0	88	67.4	56.6	148	113.4	95.1	208	159.3	133.7	268	205.3	172.3
29	22.2	18.6	89	68.2	57.2	149	114.1	95.8	209	160.1	134.3	269	206.1	172.9
30	23.0	19.3	90	68.9	57.9	150	114.9	96.4	210	160.9	135.0	270	206.8	173.6
31	23.7	19.9	91	69.7	58.5	151	115.7	97.1	211	161.6	135.6	271	207.6	174.2
32	24.5	20.6	92	70.5	59.1	152	116.4	97.7	212	162.4	136.3	272	208.4	174.8
33	25.3	21.2	93	71.2	59.8	153	117.2	98.3	213	163.2	136.9	273	209.1	175.5
34	26.0	21.9	94	72.0	60.4	154	118.0	99.0	214	163.9	137.6	274	209.9	176.1
35	26.8	22.5	95	72.8	61.1	155	118.7	99.6	215	164.7	138.2	275	210.7	176.8
36	27.6	23.1	96	73.5	61.7	156	119.5	100.3	216	165.5	138.8	276	211.4	177.4
37	28.3	23.8	97	74.3	62.4	157	120.3	100.9	217	166.2	139.5	277	212.2	178.1
38	29.1	24.4	98	75.1	63.0	158	121.0	101.6	218	167.0	140.1	278	213.0	178.7
39	29.9	25.1	99	75.8	63.6	159	121.8	102.2	219	167.8	140.8	279	213.7	179.3
40	30.6	25.7	100	76.6	64.3	160	122.6	102.8	220	168.5	141.4	280	214.5	180.0
41	31.4	26.4	101	77.4	64.9	161	123.3	103.5	221	169.3	142.1	281	215.3	180.6
42	32.2	27.0	102	78.1	65.6	162	124.1	104.1	222	170.1	142.7	282	216.0	181.3
43	32.9	27.6	103	78.9	66.2	163	124.9	104.8	223	170.8	143.3	283	216.8	181.9
44	33.7	28.3	104	79.7	66.8	164	125.6	105.4	224	171.6	144.0	284	217.6	182.6
45	34.5	28.9	105	80.4	67.5	165	126.4	106.1	225	172.4	144.6	285	218.3	183.2
46	35.2	29.6	106	81.2	68.1	166	127.2	106.7	226	173.1	145.3	286	219.1	183.8
47	36.0	30.2	107	82.0	68.8	167	127.9	107.3	227	173.9	145.9	287	219.9	184.5
48	36.8	30.9	108	82.7	69.4	168	128.7	108.0	228	174.7	146.6	288	220.6	185.1
49	37.5	31.5	109	83.5	70.1	169	129.5	108.6	229	175.4	147.2	289	221.4	185.8
50	38.3	32.1	110	84.3	70.7	170	130.2	109.3	230	176.2	147.8	290	222.2	186.4
51	39.1	32.8	111	85.0	71.3	171	131.0	109.9	231	177.0	148.5	291	222.9	187.1
52	39.8	33.4	112	85.8	72.0	172	131.8	110.6	232	177.7	149.1	292	223.7	187.7
53	40.6	34.1	113	86.6	72.6	173	132.5	111.2	233	178.5	149.8	293	224.5	188.3
54	41.4	34.7	114	87.3	73.3	174	133.3	111.8	234	179.3	150.4	294	225.2	189.0
55	42.1	35.4	115	88.1	73.9	175	134.1	112.5	235	180.0	151.1	295	226.0	189.6
56	42.9	36.0	116	88.9	74.6	176	134.8	113.1	236	180.8	151.7	296	226.7	190.3
57	43.7	36.6	117	89.6	75.2	177	135.6	113.8	237	181.6	152.3	297	227.5	190.9
58	44.4	37.3	118	90.4	75.8	178	136.4	114.4	238	182.3	153.0	298	228.3	191.6
59	45.2	37.9	119	91.2	76.5	179	137.1	115.1	239	183.1	153.6	299	229.0	192.2
60	46.0	38.6	120	91.9	77.1	180	137.9	115.7	240	183.9	154.3	300	229.8	192.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist	Dep.	Lat.	Dist.	Dep.	Lat.

For 50 Degrees.

TABLE II.

Difference of Latitude and Departure for 41 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.8	00.7	61	46.0	40.0	121	91.3	79.4	181	136.6	118.7	241	181.9	158.1
2	01.5	01.3	62	46.8	40.7	122	92.1	80.0	182	137.4	119.4	242	182.6	158.8
3	02.3	02.0	63	47.5	41.3	123	92.8	80.7	183	138.1	120.1	243	183.4	159.4
4	03.0	02.6	64	48.3	42.0	124	93.6	81.4	184	138.9	120.7	244	184.1	160.1
5	03.8	03.3	65	49.1	42.6	125	94.3	82.0	185	139.6	121.4	245	184.9	160.7
6	04.5	03.9	66	49.8	43.3	126	95.1	82.7	186	140.4	122.0	246	185.7	161.4
7	05.3	04.6	67	50.6	44.0	127	95.8	83.3	187	141.1	122.7	247	186.4	162.0
8	06.0	05.2	68	51.3	44.6	128	96.6	84.0	188	141.9	123.3	248	187.2	162.7
9	06.8	05.9	69	52.1	45.3	129	97.4	84.6	189	142.6	124.0	249	187.9	163.4
10	07.5	06.6	70	52.8	45.9	130	98.1	85.3	190	143.4	124.7	250	188.7	164.0
11	08.3	07.2	71	53.6	46.6	131	98.9	85.9	191	144.1	125.3	251	189.4	164.7
12	09.1	07.9	72	54.3	47.2	132	99.6	86.6	192	144.9	126.0	252	190.2	165.3
13	09.8	08.5	73	55.1	47.9	133	100.4	87.3	193	145.7	126.6	253	190.9	166.0
14	10.6	09.2	74	55.8	48.5	134	101.1	87.9	194	146.4	127.3	254	191.7	166.6
15	11.3	09.8	75	56.6	49.2	135	101.9	88.6	195	147.2	127 9	255	192.5	167.3
16	12.1	10.5	76	57.4	49.9	136	102.6	89.2	196	147.9	128.6	256	193.2	168.0
17	12.8	11.2	77	58.1	50.5	137	103.4	89.9	197	148.7	129.2	257	194.0	168.6
18	13.6	11.8	78	58.9	51.2	138	104.1	90.5	198	149.4	129.9	258	194.7	169.3
19	14.3	12.5	79	59.6	51.8	139	104.9	91.2	199	150.2	130.6	259	195.5	169.9
20	15.1	13.1	80	60.4	52.5	140	105.7	91.8	200	150.9	131.2	260	196.2	170.6
21	15.8	13.8	81	61.1	53.1	141	106.4	92.5	201	151.7	131.9	261	197.0	171.2
22	16.6	14.4	82	61.9	53.8	142	107.2	93.2	202	152.5	132.5	262	197.7	171.9
23	17.4	15.1	83	62.6	54.5	143	107.9	93.8	203	153.2	133.2	263	198.5	172.5
24	18.1	15.7	84	63.4	55.1	144	108.7	94.5	204	154.0	133.8	264	199.2	173.2
25	18.9	16.4	85	64.2	55.8	145	109.4	95.1	205	154.7	134.5	265	200.0	173.9
26	19.6	17.1	86	64.9	56.4	146	110.2	95.8	206	155.5	135.1	266	200.8	174.5
27	20.4	17.7	87	65 7	57.1	147	110.9	96.4	207	156.2	135.8	267	201.5	175.2
28	21.1	18.4	88	66.4	57.7	148	111.7	97.1	208	157.0	136.5	268	202.3	175.8
29	21.9	19.0	89	67.2	58.4	149	112.5	97.8	209	157.7	137.1	269	203.0	176.5
30	22.6	19.7	90	67.9	59.0	150	113.2	98.4	210	158.5	137.8	270	203.8	177.1
31	23.4	20.3	91	68.7	59.7	151	114.0	99.1	211	159.2	138.4	271	204.5	177.8
32	24.2	21.0	92	69.4	60.4	152	114.7	99.7	212	160.0	139.1	272	205.3	178.4
33	24.9	21.6	93	70.2	61.0	153	115.5	100.4	213	160.8	139.7	273	206.0	179.1
34	25.7	22.3	94	70.9	61.7	154	116.2	101.0	214	161.5	140.4	274	206.8	179.8
35	26.4	23.0	95	71.7	62.3	155	117.0	101.7	215	162.3	141.1	275	207.5	180.4
36	27.2	23.6	96	72.5	63.0	156	117.7	102.3	216	163.0	141.7	276	208.3	181.1
37	27.9	24.3	97	73.2	63.6	157	118.5	103.0	217	163.8	142.4	277	209.1	181.7
38	28.7	24.9	98	74.0	64.3	158	119.2	103.7	218	164.5	143.0	278	209.8	182.4
39	29.4	25.6	99	74.7	64.9	159	120.0	104.3	219	165.3	143.7	279	210.6	183.0
40	30.2	26.2	100	75.5	65.6	160	120.8	105.0	220	166.0	144.3	280	211.3	183.7
41	30.9	26.9	101	76.2	66.3	161	121.5	105.6	221	166.8	145.0	281	212.1	184.4
42	31.7	27.6	102	77.0	66.9	162	122.3	106.3	222	167.5	145.6	282	212.8	185 0
43	32.5	28.2	103	77.7	67.6	163	123.0	106.9	223	168.3	146.3	283	213.6	185.7
44	33.2	28.9	104	78.5	68.2	164	123.8	107.6	224	169.1	147.0	284	214.3	186.3
45	34.0	29.5	105	79.2	68.9	165	124.5	108.2	225	169.8	147.6	285	215.1	187.0
46	34.7	30.2	106	80.0	69.5	166	125.3	108.9	226	170.6	148.3	286	215.8	187.6
47	35.5	30.8	107	80.8	70.2	167	126.0	109.6	227	171.3	148.9	287	216.6	188.3
48	36.2	31.5	108	81.5	70.9	168	126.8	110.2	228	172.1	149.6	288	217.4	188.9
49	37.0	32.1	109	82.3	71.5	169	127.5	110.9	229	172.8	150.2	289	218.1	189.6
50	37.7	32.8	110	83.0	72.2	170	128.3	111.5	230	173.6	150.9	290	218.9	190.3
51	38.5	33.5	111	83.8	72.8	171	129.1	112.2	231	174.3	151.5	291	219.6	190.9
52	39.2	34.1	112	84.5	73.5	172	129.8	112.8	232	175.1	152.2	292	220.4	191.6
53	40.0	34.8	113	85.3	74.1	173	130.6	113.5	233	175.8	152.9	293	221.1	192.2
54	40.8	35.4	114	86.0	74.8	174	131.3	114.2	234	176.6	153.5	294	221.9	192.9
55	41.5	36.1	115	86.8	75.4	175	132.1	114.8	235	177.4	154.2	295	222.6	193.5
56	42.3	36.7	116	87.5	76.1	176	132.8	115.5	236	178.1	154.8	296	223.4	194.2
57	43.0	37.4	117	88.3	76.8	177	133.6	116.1	237	178.9	155.5	297	224.1	194.8
58	43.8	38.1	118	89.1	77.4	178	134.3	116.8	238	179.6	156.1	298	224.9	195.5
59	44.5	38.7	119	89.8	78.1	179	135.1	117.4	239	180.4	156.8	299	225.7	196.2
60	45.3	39.4	120	90.6	78.7	180	135.8	118.1	240	181.1	157.5	300	226.4	196.8
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 49 Degrees.

TABLE II.

Difference of Latitude and Departure for 42 Degrees

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	45.3	40.8	121	89.9	81.0	181	134.5	121.1	241	179.1	161.3
2	01.5	01.3	62	46.1	41.5	122	90.7	81.6	182	135.3	121.8	242	179.8	161.9
3	02.2	02.0	63	46.8	42.2	123	91.4	82.3	183	136.0	122.5	243	180.6	162.6
4	03.0	02.7	64	47.6	42.8	124	92.1	83.0	184	136.7	123.1	244	181.3	163.3
5	03.7	03.3	65	48.3	43.5	125	92.9	83.6	185	137.5	123.8	245	182.1	163.9
6	04.5	04.0	66	49.0	44.2	126	93.6	84.3	186	138.2	124.5	246	182.8	164.6
7	05.2	04.7	67	49.8	44.8	127	94.4	85.0	187	139.0	125.1	247	183.6	165.3
8	05.9	05.4	68	50.5	45.5	128	95.1	85.6	188	139.7	125.8	248	184.3	165.9
9	06.7	06.0	69	51.3	46.2	129	95.9	86.3	189	140.5	126.5	249	185.0	166.6
10	07.4	06.7	70	52.0	46.8	130	96.6	87.0	190	141.2	127.1	250	185.8	167.3
11	08.2	07.4	71	52.8	47.5	131	97.4	87.7	191	141.9	127.8	251	186.5	168.0
12	08.9	08.0	72	53.5	48.2	132	98.1	88.3	192	142.7	128.5	252	187.3	168.6
13	09.7	08.7	73	54.2	48.8	133	98.8	89.0	193	143.4	129.1	253	188.0	169.3
14	10.4	09.4	74	55.0	49.5	134	99.6	89.7	194	144.2	129.8	254	188.8	170.0
15	11.1	10.0	75	55.7	50.2	135	100.3	90.3	195	144.9	130.5	255	189.5	170.6
16	11.9	10.7	76	56.5	50.9	136	101.1	91.0	196	145.7	131.1	256	190.2	171.3
17	12.6	11.4	77	57.2	51.5	137	101.8	91.7	197	146.4	131.8	257	191.0	172.0
18	13.4	12.0	78	58.0	52.2	138	102.6	92.3	198	147.1	132.5	258	191.7	172.6
19	14.1	12.7	79	58.7	52.9	139	103.3	93.0	199	147.9	133.2	259	192.5	173.3
20	14.9	13.4	80	59.5	53.5	140	104.0	93.7	200	148.6	133.8	260	193.2	174.0
21	15.6	14.1	81	60.2	54.2	141	104.8	94.3	201	149.4	134.5	261	194.0	174.6
22	16.3	14.7	82	60.9	54.9	142	105.5	95.0	202	150.1	135.2	262	194.7	175.3
23	17.1	15.4	83	61.7	55.5	143	106.3	95.7	203	150.9	135.8	263	195.4	176.0
24	17.8	16.1	84	62.4	56.2	144	107.0	96.4	204	151.6	136.5	264	196.2	176.7
25	18.6	16.7	85	63.2	56.9	145	107.8	97.0	205	152.3	137.2	265	196.9	177.3
26	19.3	17.4	86	63.9	57.5	146	108.5	97.7	206	153.1	137.8	266	197.7	178.0
27	20.1	18.1	87	64.7	58.2	147	109.2	98.4	207	153.8	138.5	267	198.4	178.7
28	20.8	18.7	88	65.4	58.9	148	110.0	99.0	208	154.6	139.2	268	199.2	179.3
29	21.6	19.4	89	66.1	59.6	149	110.7	99.7	209	155.3	139.8	269	199.9	180.0
30	22.3	20.1	90	66.9	60.2	150	111.5	100.4	210	156.1	140.5	270	200.6	180.7
31	23.0	20.7	91	67.6	60.9	151	112.2	101.0	211	156.8	141.2	271	201.4	181.3
32	23.8	21.4	92	68.4	61.6	152	113.0	101.7	212	157.5	141.9	272	202.1	182.0
33	24.5	22.1	93	69.1	62.2	153	113.7	102.4	213	158.3	142.5	273	202.9	182.7
34	25.3	22.8	94	69.9	62.9	154	114.4	103.0	214	159.0	143.2	274	203.6	183.3
35	26.0	23.4	95	70.6	63.6	155	115.2	103.7	215	159.8	143.9	275	204.4	184.0
36	26.8	24.1	96	71.3	64.2	156	115.9	104.4	216	160.5	144.5	276	205.1	184.7
37	27.5	24.8	97	72.1	64.9	157	116.7	105.1	217	161.3	145.2	277	205.9	185.3
38	28.2	25.4	98	72.8	65.6	158	117.4	105.7	218	162.0	145.9	278	206.6	186.0
39	29.0	26.1	99	73.6	66.2	159	118.2	106.4	219	162.7	146.5	279	207.3	186.7
40	29.7	26.8	100	74.3	66.9	160	118.9	107.1	220	163.5	147.2	280	208.1	187.4
41	30.5	27.4	101	75.1	67.6	161	119.6	107.7	221	164.2	147.9	281	208.8	188.0
42	31.2	28.1	102	75.8	68.3	162	120.4	108.4	222	165.0	148.5	282	209.6	188.7
43	32.0	28.8	103	76.5	68.9	163	121.1	109.1	223	165.7	149.2	283	210.3	189.4
44	32.7	29.4	104	77.3	69.6	164	121.9	109.7	224	166.5	149.9	284	211.1	190.0
45	33.4	30.1	105	78.0	70.3	165	122.6	110.4	225	167.2	150.6	285	211.8	190.7
46	34.2	30.8	106	78.8	70.9	166	123.4	111.1	226	168.0	151.2	286	212.5	191.4
47	34.9	31.4	107	79.5	71.6	167	124.1	111.7	227	168.7	151.9	287	213.3	192.0
48	35.7	32.1	108	80.3	72.3	168	124.8	112.4	228	169.4	152.6	288	214.0	192.7
49	36.4	32.8	109	81.0	72.9	169	125.6	113.1	229	170.2	153.2	289	214.8	193.4
50	37.2	33.5	110	81.7	73.6	170	126.3	113.8	230	170.9	153.9	290	215.5	194.0
51	37.9	34.1	111	82.5	74.3	171	127.1	114.4	231	171.7	154.6	291	216.3	194.7
52	38.6	34.8	112	83.2	74.9	172	127.8	115.1	232	172.4	155.2	292	217.0	195.4
53	39.4	35.5	113	84.0	75.6	173	128.6	115.8	233	173.2	155.9	293	217.7	196.1
54	40.1	36.1	114	84.7	76.3	174	129.3	116.4	234	173.9	156.6	294	218.5	196.7
55	40.9	36.8	115	85.5	77.0	175	130.1	117.1	235	174.6	157.2	295	219.2	197.4
56	41.6	37.5	116	86.2	77.6	176	130.8	117.8	236	175.4	157.9	296	220.0	198.1
57	42.4	38.1	117	86.9	78.3	177	131.5	118.4	237	176.1	158.6	297	220.7	198.7
58	43.1	38.8	118	87.7	79.0	178	132.3	119.1	238	176.9	159.3	298	221.5	199.4
59	43.8	39.5	119	88.4	79.6	179	133.0	119.8	239	177.6	159.9	299	222.2	200.1
60	44.6	40.1	120	89.2	80.3	180	133.8	120.4	240	178.4	160.6	300	222.9	200.7
Dist	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 48 Degrees.

TABLE II.

Difference of Latitude and Departure for 43 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	44.6	41.6	121	88.5	82.5	181	132.4	123.4	241	176.3	164.4
2	01.5	01.4	62	45.3	42.3	122	89.2	83.2	182	133.1	124.1	242	177.0	165.0
3	02.2	02.0	63	46.1	43.0	123	90.0	83.9	183	133.8	124.8	243	177.7	165.7
4	02.9	02.7	64	46.8	43.6	124	90.7	84.6	184	134.6	125.5	244	178.5	166.4
5	03.7	03.4	65	47.5	44.3	125	91.4	85.2	185	135.3	126.2	245	179.2	167.1
6	04.4	04.1	66	48.3	45.0	126	92.2	85.9	186	136.0	126.9	246	179.9	167.8
7	05.1	04.8	67	49.0	45.7	127	92.9	86.6	187	136.8	127.5	247	180.6	168.5
8	05.9	05.5	68	49.7	46.4	128	93.6	87.3	188	137.5	128.2	248	181.4	169.1
9	06.6	06.1	69	50.5	47.1	129	94.3	88.0	189	138.2	128.9	249	182.1	169.8
10	07.3	06.8	70	51.2	47.7	130	95.1	88.7	190	139.0	129.6	250	182.8	170.5
11	08.0	07.5	71	51.9	48.4	131	95.8	89.3	191	139.7	130.3	251	183.6	171.2
12	08.8	08.2	72	52.7	49.1	132	96.5	90.0	192	140.4	130.9	252	184.3	171.9
13	09.5	08.9	73	53.4	49.8	133	97.3	90.7	193	141.2	131.6	253	185.0	172.5
14	10.2	09.5	74	54.1	50.5	134	98.0	91.4	194	141.9	132.3	254	185.8	173.2
15	11.0	10.2	75	54.9	51.1	135	98.7	92.1	195	142.6	133.0	255	186.5	173.9
16	11.7	10.9	76	55.6	51.8	136	99.5	92.8	196	143.3	133.7	256	187.2	174.6
17	12.4	11.6	77	56.3	52.5	137	100.2	93.4	197	144.1	134.4	257	188.0	175.3
18	13.2	12.3	78	57.0	53.2	138	100.9	94.1	198	144.8	135.0	258	188.7	176.0
19	13.9	13.0	79	57.8	53.9	139	101.7	94.8	199	145.5	135.7	259	189.4	176.6
20	14.6	13.6	80	58.5	54.6	140	102.4	95.5	200	146.3	136.4	260	190.2	177.3
21	15.4	14.3	81	59.2	55.2	141	103.1	96.2	201	147.0	137.1	261	190.9	178.0
22	16.1	15.0	82	60.0	55.9	142	103.9	96.8	202	147.7	137.8	262	191.6	178.7
23	16.8	15.7	83	60.7	56.6	143	104.6	97.5	203	148.5	138.4	263	192.3	179.4
24	17.6	16.4	84	61.4	57.3	144	105.3	98.2	204	149.2	139.1	264	193.1	180.0
25	18.3	17.0	85	62.2	58.0	145	106.0	98.9	205	149.9	139.8	265	193.8	180.7
26	19.0	17.7	86	62.9	58.7	146	106.8	99.6	206	150.7	140.5	266	194.5	181.4
27	19.7	18.4	87	63.6	59.3	147	107.5	100.3	207	151.4	141.2	267	195.3	182.1
28	20.5	19.1	88	64.4	60.0	148	108.2	100.9	208	152.1	141.9	268	196.0	182.8
29	21.2	19.8	89	65.1	60.7	149	109.0	101.6	209	152.9	142.5	269	196.7	183.5
30	21.9	20.5	90	65.8	61.4	150	109.7	102.3	210	153.6	143.2	270	197.5	184.1
31	22.7	21.1	91	66.6	62.1	151	110.4	103.0	211	154.3	143.9	271	198.2	184.8
32	23.4	21.8	92	67.3	62.7	152	111.2	103.7	212	155.0	144.6	272	198.9	185.5
33	24.1	22.5	93	68.0	63.4	153	111.9	104.3	213	155.8	145.3	273	199.7	186.2
34	24.9	23.2	94	68.7	64.1	154	112.6	105.0	214	156.5	145.9	274	200.4	186.9
35	25.6	23.9	95	69.5	64.8	155	113.4	105.7	215	157.2	146.6	275	201.1	187.5
36	26.3	24.6	96	70.2	65.5	156	114.1	106.4	216	158.0	147.3	276	201.9	188.2
37	27.1	25.2	97	70.9	66.2	157	114.8	107.1	217	158.7	148.0	277	202.6	188.9
38	27.8	25.9	98	71.7	66.8	158	115.6	107.8	218	159.4	148.7	278	203.3	189.6
39	28.5	26.6	99	72.4	67.5	159	116.3	108.4	219	160.2	149.4	279	204.0	190.3
40	29.3	27.3	100	73.1	68.2	160	117.0	109.1	220	160.9	150.0	280	204.8	191.0
41	30.0	28.0	101	73.9	68.9	161	117.7	109.8	221	161.6	150.7	281	205.5	191.6
42	30.7	28.6	102	74.6	69.6	162	118.5	110.5	222	162.4	151.4	282	206.2	192.3
43	31.4	29.3	103	75.3	70.2	163	119.2	111.2	223	163.1	152.1	283	207.0	193.0
44	32.2	30.0	104	76.1	70.9	164	119.9	111.8	224	163.8	152.8	284	207.7	193.7
45	32.9	30.7	105	76.8	71.6	165	120.7	112.5	225	164.6	153.4	285	208.4	194.4
46	33.6	31.4	106	77.5	72.3	166	121.4	113.2	226	165.3	154.1	286	209.2	195.1
47	34.4	32.1	107	78.3	73.0	167	122.1	113.9	227	166.0	154.8	287	209.9	195.7
48	35.1	32.7	108	79.0	73.7	168	122.9	114.6	228	166.7	155.5	288	210.6	196.4
49	35.8	33.4	109	79.7	74.3	169	123.6	115.3	229	167.5	156.2	289	211.4	197.1
50	36.6	34.1	110	80.4	75.0	170	124.3	115.9	230	168.2	156.9	290	212.1	197.8
51	37.3	34.8	111	81.2	75.7	171	125.1	116.6	231	168.9	157.5	291	212.8	198.5
52	38.0	35.5	112	81.9	76.4	172	125.8	117.3	232	169.7	158.2	292	213.6	199.1
53	38.8	36.1	113	82.6	77.1	173	126.5	118.0	233	170.4	158.9	293	214.3	199.8
54	39.5	36.8	114	83.4	77.7	174	127.3	118.7	234	171.1	159.6	294	215.0	200.5
55	40.2	37.5	115	84.1	78.4	175	128.0	119.3	235	171.9	160.3	295	215.7	201.2
56	41.0	38.2	116	84.8	79.1	176	128.7	120.0	236	172.6	161.0	296	216.5	201.9
57	41.7	38.9	117	85.6	79.8	177	129.4	120.7	237	173.3	161.6	297	217.2	202.6
58	42.4	39.6	118	86.3	80.5	178	130.2	121.4	238	174.1	162.3	298	217.9	203.2
59	43.1	40.2	119	87.0	81.2	179	130.9	122.1	239	174.8	163.0	299	218.7	203.9
60	43.9	40.9	120	87.8	81.8	180	131.6	122.8	240	175.5	163.7	300	219.4	204.6
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 47 Degrees.

TABLE II.

Difference of Latitude and Departure for 44 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist	Lat.	Dep.
1	00.7	00.7	61	43.9	42.4	121	87.0	84.1	181	130.2	125.7	241	173.4	167.4
2	01.4	01.4	62	44.6	43.1	122	87.8	84.7	182	130.9	126.4	242	174.1	168.1
3	02.2	02.1	63	45.3	43.8	123	88.5	85.4	183	131.6	127.1	243	174.8	168.8
4	02.9	02.8	64	46.0	44.5	124	89.2	86.1	184	132.4	127.8	244	175.5	169.5
5	03.6	03.5	65	46.8	45.2	125	89.9	86.8	185	133.1	128.5	245	176.2	170.2
6	04.3	04.2	66	47.5	45.8	126	90.6	87.5	186	133.8	129.2	246	177.0	170.9
7	05.0	04.9	67	48.2	46.5	127	91.4	88.2	187	134.5	129.9	247	177.7	171.6
8	05.8	05.6	68	48.9	47.2	128	92.1	88.9	188	135.2	130.6	248	178.4	172.3
9	06.5	06.3	69	49.6	47.9	129	92.8	89.6	189	136.0	131.3	249	179.1	173.0
10	07.2	06.9	70	50.4	48.6	130	93.5	90.3	190	136.7	132.0	250	179.8	173.7
11	07.9	07.6	71	51.1	49.3	131	94.2	91.0	191	137.4	132.7	251	180.6	174.4
12	08.6	08.3	72	51.8	50.0	132	95.0	91.7	192	138.1	133.4	252	181.3	175.1
13	09.4	09.0	73	52.5	50.7	133	95.7	92.4	193	138.8	134.1	253	182.0	175.7
14	10.1	09.7	74	53.2	51.4	134	96.4	93.1	194	139.6	134.8	254	182.7	176.4
15	10.8	10.4	75	54.0	52.1	135	97.1	93.8	195	140.3	135.5	255	183.4	177.1
16	11.5	11.1	76	54.7	52.8	136	97.8	94.5	196	141.0	136.2	256	184.2	177.8
17	12.2	11.8	77	55.4	53.5	137	98.5	95.2	197	141.7	136.8	257	184.9	178.5
18	12.9	12.5	78	56.1	54.2	138	99.3	95.9	198	142.4	137.5	258	185.6	179.2
19	13.7	13.2	79	56.8	54.9	139	100.0	96.6	199	143.1	138.2	259	186.3	179.9
20	14.4	13.9	80	57.5	55.6	140	100.7	97.3	200	143.9	138.9	260	187.0	180.6
21	15.1	14.6	81	58.3	56.3	141	101.4	97.9	201	144.6	139.6	261	187.7	181.3
22	15.8	15.3	82	59.0	57.0	142	102.1	98.6	202	145.3	140.3	262	188.5	182.0
23	16.5	16.0	83	59.7	57.7	143	102.9	99.3	203	146.0	141.0	263	189.2	182.7
24	17.3	16.7	84	60.4	58.4	144	103.6	100.0	204	146.7	141 7	264	189.9	183.4
25	18.0	17.4	85	61.1	59.0	145	104.3	100.7	205	147.5	142.4	265	190.6	184.1
26	18.7	18.1	86	61.9	59.7	146	105.0	101.4	206	148.2	143.1	266	191.3	184.8
27	19.4	18.8	87	62.6	60.4	147	105.7	102.1	207	148.9	143.8	267	192.1	185.5
28	20.1	19.5	88	63.3	61.1	148	106.5	102.8	208	149.6	144.5	268	192.8	186.2
29	20.9	20.1	89	64.0	61.8	149	107.2	103.5	209	150.3	145.2	269	193.5	186.9
30	21.6	20.8	90	64.7	62.5	150	107.9	104.2	210	151.1	145.9	270	194.2	187.6
31	22.3	21.5	91	65.5	63.2	151	108.6	104.9	211	151.8	146.6	271	194.9	188.3
32	23.0	22.2	92	66.2	63.9	152	109.3	105.6	212	152.5	147.3	272	195.7	188.9
33	23.7	22.9	93	66.9	64.6	153	110.1	106.3	213	153.2	148.0	273	196 4	189.6
34	24.5	23.6	94	67.6	65.3	154	110.8	107.0	214	153.9	148.7	274	197.1	190.3
35	25.2	24.3	95	68.3	66.0	155	111.5	107.7	215	154.7	149.4	275	197.8	191.0
36	25.9	25.0	96	69.1	66.7	156	112.2	108.4	216	155.4	150.0	276	198.5	191.7
37	26.6	25.7	97	69.8	67.4	157	112.9	109.1	217	156.1	150.7	277	199.3	192.4
38	27.3	26.4	98	70.5	68.1	158	113.7	109.8	218	156.8	151.4	278	200.0	193 1
39	28.1	27.1	99	71.2	68.8	159	114.4	110.5	219	157.5	152.1	279	200.7	193.8
40	28.8	27.8	100	71.9	69.5	160	115.1	111.1	220	158.3	152.8	280	201.4	194.5
41	29.5	28.5	101	72.7	70.2	161	115.8	111.8	221	159.0	153.5	281	202.1	195.2
42	30.2	29.2	102	73.4	70.9	162	116.5	112.5	222	159.7	154.2	282	202.9	195.9
43	30.9	29.9	103	74.1	71.5	163	117.3	113.2	223	160.4	154.9	283	203.6	196.6
44	31.7	30.6	104	74.8	72.2	164	118.0	113.9	224	161.1	155.6	284	204.3	197.3
45	32.4	31.3	105	75.5	72.9	165	118.7	114.6	225	161.9	156.3	285	205.0	198.0
46	33.1	32.0	106	76.3	73.6	166	119.4	115.3	226	162.6	157.0	286	205.7	198.7
47	33.8	32.6	107	77.0	74.3	167	120.1	116.0	227	163.3	157.7	287	206.5	199.4
48	34.5	33.3	108	77.7	75.0	168	120.8	116.7	228	164.0	158.4	288	207.2	200.1
49	35.2	34.0	109	78.4	75.7	169	121.6	117.4	229	164.7	159.1	289	207.9	200.8
50	36.0	34.7	110	79.1	76.4	170	122.3	118.1	230	165.4	159.8	290	208.6	201.5
51	36.7	35.4	111	79.8	77.1	171	123.0	118.8	231	166.2	160.5	291	209.3	202.1
52	37.4	36.1	112	80.6	77.8	172	123.7	119.5	232	166.9	161.2	292	210.0	202.8
53	38.1	36.8	113	81.3	78.5	173	124.4	120.2	233	167.6	161.9	293	210.8	203.5
54	38.8	37.5	114	82.0	79.2	174	125.2	120.9	234	168.3	162.6	294	211.5	204.2
55	39.6	38.2	115	82.7	79.9	175	125.9	121.6	235	169.0	163.2	295	212.2	204.9
56	40.3	38.9	116	83.4	80.6	176	126.6	122.3	236	169.8	163.9	296	212.9	205.6
57	41.0	39.6	117	84.2	81.3	177	127.3	123.0	237	170.5	164.6	297	213.6	206.3
58	41.7	40.3	118	84.9	82.0	178	128.0	123.6	238	171.2	165.3	298	214.4	207.0
59	42.4	41.0	119	85.6	82.7	179	128.8	124.3	239	171.9	166.0	299	215.1	207.7
60	43.2	41.7	120	86.3	83.4	180	129.5	125.0	240	172.6	166.7	300	215.8	208.4
Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

For 46 Degrees.

TABLE II.

Difference of Latitude and Departure for 45 Degrees.

Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.	Dist.	Lat.	Dep.
1	00.7	00.7	61	43.1	43.1	121	85.6	85.6	181	128.0	128.0	241	170.4	170.4
2	01.4	01.4	62	43.8	43.8	122	86.3	86.3	182	128.7	128.7	242	171.1	171.1
3	02.1	02.1	63	44.5	44.5	123	87.0	87.0	183	129.4	129.4	243	171.8	171.8
4	02.8	02.8	64	45.3	45.3	124	87.7	87.7	184	130.1	130.1	244	172.5	172.5
5	03.5	03.5	65	46.0	46.0	125	88.4	88.4	185	130.8	130.8	245	173.2	173.2
6	04.2	04.2	66	46.7	46.7	126	89.1	89.1	186	131.5	131.5	246	173.9	173.9
7	04.9	04.9	67	47.4	47.4	127	89.8	89.8	187	132.2	132.2	247	174.7	174.7
8	05.7	05.7	68	48.1	48.1	128	90.5	90.5	188	132.9	132.9	248	175.4	175.4
9	06.4	06.4	69	48.8	48.8	129	91.2	91.2	189	133.6	133.6	249	176.1	176.1
10	07.1	07.1	70	49.5	49.5	130	91.9	91.9	190	134.3	134.3	250	176.8	176.8
11	07.8	07.8	71	50.2	50.2	131	92.6	92.6	191	135.1	135.1	251	177.5	177.5
12	08.5	08.5	72	50.9	50.9	132	93.3	93.3	192	135.8	135.8	252	178.2	178.2
13	09.2	09.2	73	51.6	51.6	133	94.0	94.0	193	136.5	136.5	253	178.9	178.9
14	09.9	09.9	74	52.3	52.3	134	94.8	94.8	194	137.2	137.2	254	179.6	179.6
15	10.6	10.6	75	53.0	53.0	135	95.5	95.5	195	137.9	137.9	255	180.3	180.3
16	11.3	11.3	76	53.7	53.7	136	96.2	96.2	196	138.6	138.6	256	181.0	181.0
17	12.0	12.0	77	54.4	54.4	137	96.9	96.9	197	139.3	139.3	257	181.7	181.7
18	12.7	12.7	78	55.2	55.2	138	97.6	97.6	198	140.0	140.0	258	182.4	182.4
19	13.4	13.4	79	55.9	55.9	139	98.3	98.3	199	140.7	140.7	259	183.1	183.1
20	14.1	14.1	80	56.6	56.6	140	99.0	99.0	200	141.4	141.4	260	183.8	183.8
21	14.8	14.8	81	57.3	57.3	141	99.7	99.7	201	142.1	142.1	261	184.6	184.6
22	15.6	15.6	82	58.0	58.0	142	100.4	100.4	202	142.8	142.8	262	185.3	185.3
23	16.3	16.3	83	58.7	58.7	143	101.1	101.1	203	143.5	143.5	263	186.0	186.0
24	17.0	17.0	84	59.4	59.4	144	101.8	101.8	204	144.2	144.2	264	186.7	186.7
25	17.7	17.7	85	60.1	60.1	145	102.5	102.5	205	145.0	145.0	265	187.4	187.4
26	18.4	18.4	86	60.8	60.8	146	103.2	103.2	206	145.7	145.7	266	188.1	188.1
27	19.1	19.1	87	61.5	61.5	147	103.9	103.9	207	146.4	146.4	267	188.8	188.8
28	19.8	19.8	88	62.2	62.2	148	104.7	104.7	208	147.1	147.1	268	189.5	189.5
29	20.5	20.5	89	62.9	62.9	149	105.4	105.4	209	147.8	147.8	269	190.2	190.2
30	21.2	21.2	90	63.6	63.6	150	106.1	106.1	210	148.5	148.5	270	190.9	190.9
31	21.9	21.9	91	64.3	64.3	151	106.8	106.8	211	149.2	149.2	271	191.6	191.6
32	22.6	22.6	92	65.1	65.1	152	107.5	107.5	212	149.9	149.9	272	192.3	192.3
33	23.3	23.3	93	65.8	65.8	153	108.2	108.2	213	150.6	150.6	273	193.0	193.0
34	24.0	24.0	94	66.5	66.5	154	108.9	108.9	214	151.3	151.3	274	193.7	193.7
35	24.7	24.7	95	67.2	67.2	155	109.6	109.6	215	152.0	152.0	275	194.5	194.5
36	25.5	25.5	96	67.9	67.9	156	110.3	110.3	216	152.7	152.7	276	195.2	195.2
37	26.2	26.2	97	68.6	68.6	157	111.0	111.0	217	153.4	153.4	277	195.9	195.9
38	26.9	26.9	98	69.3	69.3	158	111.7	111.7	218	154.1	154.1	278	196.6	196.6
39	27.6	27.6	99	70.0	70.0	159	112.4	112.4	219	154.9	154.9	279	197.3	197.3
40	28.3	28.3	100	70.7	70.7	160	113.1	113.1	220	155.6	155.6	280	198.0	198.0
41	29.0	29.0	101	71.4	71.4	161	113.8	113.8	221	156.3	156.3	281	198.7	198.7
42	29.7	29.7	102	72.1	72.1	162	114.5	114.5	222	157.0	157.0	282	199.4	199.4
43	30.4	30.4	103	72.8	72.8	163	115.3	115.3	223	157.7	157.7	283	200.1	200.1
44	31.1	31.1	104	73.5	73.5	164	116.0	116.0	224	158.4	158.4	284	200.8	200.8
45	31.8	31.8	105	74.2	74.2	165	116.7	116.7	225	159.1	159.1	285	201.5	201.5
46	32.5	32.5	106	75.0	75.0	166	117.4	117.4	226	159.8	159.8	286	202.2	202.2
47	33.2	33.2	107	75.7	75.7	167	118.1	118.1	227	160.5	160.5	287	202.9	202.9
48	33.9	33.9	108	76.4	76.4	168	118.8	118.8	228	161.2	161.2	288	203.6	203.6
49	34.6	34.6	109	77.1	77.1	169	119.5	119.5	229	161.9	161.9	289	204.3	204.3
50	35.4	35.4	110	77.8	77.8	170	120.2	120.2	230	162.6	162.6	290	205.1	205.1
51	36.1	36.1	111	78.5	78.5	171	120.9	120.9	231	163.3	163.3	291	205.8	205.8
52	36.8	36.8	112	79.2	79.2	172	121.6	121.6	232	164.0	164.0	292	206.5	206.5
53	37.5	37.5	113	79.9	79.9	173	122.3	122.3	233	164.8	164.8	293	207.2	207.2
54	38.2	38.2	114	80.6	80.6	174	123.0	123.0	234	165.5	165.5	294	207.9	207.9
55	38.9	38.9	115	81.3	81.3	175	123.7	123.7	235	166.2	166.2	295	208.6	208.6
56	39.6	39.6	116	82.0	82.0	176	124.4	124.4	236	166.9	166.9	296	209.3	209.3
57	40.3	40.3	117	82.7	82.7	177	125.2	125.2	237	167.6	167.6	297	210.0	210.0
58	41.0	41.0	118	83.4	83.4	178	125.9	125.9	238	168.3	168.3	298	210.7	210.7
59	41.7	41.7	119	84.1	84.1	179	126.6	126.6	239	169.0	169.0	299	211.4	211.4
60	42.4	42.4	120	84.9	84.9	180	127.3	127.3	240	169.7	169.7	300	212.1	212.1
Dist.	Dep.	Lat.	Dist.	Dep	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.	Dist.	Dep.	Lat.

TABLE III.

MERIDIONAL PARTS.

M	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	M
0	0	60	120	180	240	300	361	421	482	542	603	664	725	787	849	0
1	1	61	121	181	241	301	362	422	483	543	604	665	726	788	850	1
2	2	62	122	182	242	302	363	423	484	544	605	666	727	789	851	2
3	3	63	123	183	243	303	364	424	485	545	606	667	728	790	852	3
4	4	64	124	184	244	304	365	425	486	546	607	668	729	791	853	4
5	5	65	125	185	245	305	366	426	487	547	608	669	730	792	854	5
6	6	66	126	186	246	306	367	427	488	548	609	670	731	793	855	6
7	7	67	127	187	247	307	368	428	489	549	610	671	732	794	856	7
8	8	68	128	188	248	308	369	429	490	550	611	672	734	795	857	8
9	9	69	129	189	249	309	370	430	491	551	612	673	735	796	858	9
10	10	70	130	190	250	310	371	431	492	552	613	674	736	797	859	10
11	11	71	131	191	251	311	372	432	493	553	614	675	737	798	860	11
12	12	72	132	192	252	312	373	433	494	554	615	676	738	799	861	12
13	13	73	133	193	253	313	374	434	495	555	616	677	739	800	862	13
14	14	74	134	194	254	314	375	435	496	556	617	678	740	801	863	14
15	15	75	135	195	255	315	376	436	497	557	618	679	741	802	864	15
16	16	76	136	196	256	316	377	437	498	558	619	680	742	803	865	16
17	17	77	137	197	257	317	378	438	499	559	620	681	743	804	866	17
18	18	78	138	198	258	318	379	439	500	560	621	682	744	805	867	18
19	19	79	139	199	259	319	380	440	501	561	622	683	745	806	868	19
20	20	80	140	200	260	320	381	441	502	562	623	684	746	807	869	20
21	21	81	141	201	261	321	382	442	503	564	624	685	747	808	870	21
22	22	82	142	202	262	322	383	443	504	565	625	687	748	809	871	22
23	23	83	143	203	263	323	384	444	505	566	626	688	749	810	872	23
24	24	84	144	204	264	324	385	445	506	567	627	689	750	811	873	24
25	25	85	145	205	265	325	386	446	507	568	628	690	751	812	874	25
26	26	86	146	206	266	326	387	447	508	569	629	691	752	813	875	26
27	27	87	147	207	267	327	388	448	509	570	631	692	753	815	876	27
28	28	88	148	208	268	328	389	449	510	571	632	693	754	816	877	28
29	29	89	149	209	269	330	390	450	511	572	633	694	755	817	878	29
30	30	90	150	210	270	331	391	451	512	573	634	695	756	818	879	30
31	31	91	151	211	271	332	392	452	513	574	635	696	757	819	880	31
32	32	92	152	212	272	333	393	453	514	575	636	697	758	820	882	32
33	33	93	153	213	273	334	394	454	515	576	637	698	759	821	883	33
34	34	94	154	214	274	335	395	455	516	577	638	699	760	822	884	34
35	35	95	155	215	275	336	396	456	517	578	639	700	761	823	885	35
36	36	96	156	216	276	337	397	457	518	579	640	701	762	824	886	36
37	37	97	157	217	277	338	398	458	519	580	641	702	763	825	887	37
38	38	98	158	218	278	339	399	459	520	581	642	703	764	826	888	38
39	39	99	159	219	279	340	400	460	521	582	643	704	765	827	889	39
40	40	100	160	220	280	341	401	461	522	583	644	705	766	828	890	40
41	41	101	161	221	281	342	402	462	523	584	645	706	767	829	891	41
42	42	102	162	222	282	343	403	463	524	585	646	707	768	830	892	42
43	43	103	163	223	283	344	404	464	525	586	647	708	769	831	893	43
44	44	104	164	224	284	345	405	465	526	587	648	709	770	832	894	44
45	45	105	165	225	285	346	406	466	527	588	649	710	771	833	895	45
46	46	106	166	226	286	347	407	467	528	589	650	711	772	834	896	46
47	47	107	167	227	287	348	408	468	529	590	651	712	773	835	897	47
48	48	108	168	228	288	349	409	469	530	591	652	713	774	836	898	48
49	49	109	169	229	289	350	410	470	531	592	653	714	776	837	899	49
50	50	110	170	230	290	351	411	471	532	593	654	715	777	838	900	50
51	51	111	171	231	291	352	412	472	533	594	655	716	778	839	901	51
52	52	112	172	232	292	353	413	473	534	595	656	717	779	840	902	52
53	53	113	173	233	293	354	414	474	535	596	657	718	780	841	903	53
54	54	114	174	234	294	355	415	476	536	597	658	719	781	842	904	54
55	55	115	175	235	295	356	416	477	537	598	659	720	782	843	905	55
56	56	116	176	236	296	357	417	478	538	599	660	721	783	844	906	56
57	57	117	177	237	297	358	418	479	539	600	661	722	784	845	907	57
58	58	118	178	238	298	359	419	480	540	601	662	723	785	846	908	58
59	59	119	179	239	299	360	420	481	541	602	663	724	786	847	909	59
M	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	M

TABLE III.

MERIDIONAL PARTS.

M	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	M
0	910	973	1035	1098	1161	1225	1289	1354	1419	1484	1550	1616	0
1	912	974	1036	1099	1163	1226	1290	1355	1420	1485	1551	1618	1
2	913	975	1037	1100	1164	1227	1291	1356	1421	1486	1552	1619	2
3	914	976	1038	1101	1165	1228	1292	1357	1422	1487	1553	1620	3
4	915	977	1039	1102	1166	1229	1293	1358	1423	1488	1554	1621	4
5	916	978	1041	1103	1167	1230	1295	1359	1424	1490	1556	1622	5
6	917	979	1042	1105	1168	1232	1296	1360	1425	1491	1557	1623	6
7	918	980	1043	1106	1169	1233	1297	1361	1426	1492	1558	1624	7
8	919	981	1044	1107	1170	1234	1298	1362	1427	1493	1559	1625	8
9	920	982	1045	1108	1171	1235	1299	1363	1428	1494	1560	1626	9
10	921	983	1046	1109	1172	1236	1300	1364	1430	1495	1561	1628	10
11	922	984	1047	1110	1173	1237	1301	1366	1431	1496	1562	1629	11
12	923	985	1048	1111	1174	1238	1302	1367	1432	1497	1563	1630	12
13	924	986	1049	1112	1175	1239	1303	1368	1433	1498	1564	1631	13
14	925	987	1050	1113	1176	1240	1304	1369	1434	1499	1565	1632	14
15	926	988	1051	1114	1177	1241	1305	1370	1435	1500	1567	1633	15
16	927	989	1052	1115	1178	1242	1306	1371	1436	1502	1568	1634	16
17	928	990	1053	1116	1179	1243	1307	1372	1437	1503	1569	1635	17
18	929	991	1054	1117	1181	1244	1308	1373	1438	1504	1570	1637	18
19	930	993	1055	1118	1182	1245	1310	1374	1439	1505	1571	1638	19
20	931	994	1056	1119	1183	1246	1311	1375	1440	1506	1572	1639	20
21	932	995	1057	1120	1184	1248	1312	1376	1441	1507	1573	1640	21
22	933	996	1058	1121	1185	1249	1313	1377	1443	1508	1574	1641	22
23	934	997	1059	1122	1186	1250	1314	1379	1444	1509	1575	1642	23
24	935	998	1060	1123	1187	1251	1315	1380	1445	1510	1577	1643	24
25	936	999	1061	1125	1188	1252	1316	1381	1446	1511	1578	1644	25
26	937	1000	1063	1126	1189	1253	1317	1382	1447	1513	1579	1645	26
27	938	1001	1064	1127	1190	1254	1318	1383	1448	1514	1580	1647	27
28	939	1002	1065	1128	1191	1255	1319	1384	1449	1515	1581	1648	28
29	941	1003	1066	1129	1192	1256	1320	1385	1450	1516	1582	1649	29
30	942	1004	1067	1130	1193	1257	1321	1386	1451	1517	1583	1650	30
31	943	1005	1068	1131	1194	1258	1322	1387	1452	1518	1584	1651	31
32	944	1006	1069	1132	1195	1259	1324	1388	1453	1519	1585	1652	32
33	945	1007	1070	1133	1196	1260	1325	1389	1455	1520	1586	1653	33
34	946	1008	1071	1134	1198	1261	1326	1390	1456	1521	1588	1654	34
35	947	1009	1072	1135	1199	1262	1327	1392	1457	1522	1589	1656	35
36	948	1010	1073	1136	1200	1264	1328	1393	1458	1524	1590	1657	36
37	949	1011	1074	1137	1201	1265	1329	1394	1459	1525	1591	1658	37
38	950	1012	1075	1138	1202	1266	1330	1395	1460	1526	1592	1659	38
39	951	1013	1076	1139	1203	1267	1331	1396	1461	1527	1593	1660	39
40	952	1014	1077	1140	1204	1268	1332	1397	1462	1528	1594	1661	40
41	953	1015	1078	1141	1205	1269	1333	1398	1463	1529	1595	1662	41
42	954	1016	1079	1142	1206	1270	1334	1399	1464	1530	1596	1663	42
43	955	1018	1080	1144	1207	1271	1335	1400	1465	1531	1598	1664	43
44	956	1019	1081	1145	1208	1272	1336	1401	1467	1532	1599	1666	44
45	957	1020	1082	1146	1209	1273	1338	1402	1468	1533	1600	1667	45
46	958	1021	1084	1147	1210	1274	1339	1403	1469	1535	1601	1668	46
47	959	1022	1085	1148	1211	1275	1340	1405	1470	1536	1602	1669	47
48	960	1023	1086	1149	1212	1276	1341	1406	1471	1537	1603	1670	48
49	961	1024	1087	1150	1213	1277	1342	1407	1472	1538	1604	1671	49
50	962	1025	1088	1151	1215	1278	1343	1408	1473	1539	1605	1672	50
51	963	1026	1089	1152	1216	1280	1344	1409	1474	1540	1606	1673	51
52	964	1027	1090	1153	1217	1281	1345	1410	1475	1541	1608	1675	52
53	965	1028	1091	1154	1218	1282	1346	1411	1476	1542	1609	1676	53
54	966	1029	1092	1155	1219	1283	1347	1412	1477	1543	1610	1677	54
55	968	1030	1093	1156	1220	1284	1348	1413	1479	1544	1611	1678	55
56	969	1031	1094	1157	1221	1285	1349	1414	1480	1546	1612	1679	56
57	970	1032	1095	1158	1222	1286	1350	1415	1481	1547	1613	1680	57
58	971	1033	1096	1159	1223	1287	1352	1416	1482	1548	1614	1681	58
59	972	1034	1097	1160	1224	1288	1353	1418	1483	1549	1615	1682	59
M	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	M

TABLE III.

MERIDIONAL PARTS.

M	27°	28°	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	M
0	1684	1751	1819	1888	1958	2028	2100	2171	2244	2318	2393	2468	0
1	1685	1752	1821	1890	1959	2030	2101	2173	2246	2319	2394	2470	1
2	1686	1753	1822	1891	1960	2031	2102	2174	2247	2320	2395	2471	2
3	1687	1755	1823	1892	1962	2032	2103	2175	2248	2322	2396	2472	3
4	1688	1756	1824	1893	1963	2033	2104	2176	2249	2323	2398	2473	4
5	1689	1757	1825	1894	1964	2034	2105	2178	2250	2324	2399	2475	5
6	1690	1758	1826	1895	1965	2035	2107	2179	2252	2325	2400	2476	6
7	1691	1759	1827	1896	1966	2037	2108	2180	2253	2327	2401	2477	7
8	1693	1760	1829	1898	1967	2038	2109	2181	2254	2328	2403	2478	8
9	1694	1761	1830	1899	1969	2039	2110	2182	2255	2329	2404	2480	9
10	1695	1762	1831	1900	1970	2040	2111	2184	2257	2330	2405	2481	10
11	1696	1764	1832	1901	1971	2041	2113	2185	2258	2332	2406	2482	11
12	1697	1765	1833	1902	1972	2043	2114	2186	2259	2333	2408	2484	12
13	1698	1766	1834	1903	1973	2044	2115	2187	2260	2334	2409	2485	13
14	1699	1767	1835	1905	1974	2045	2116	2188	2261	2335	2410	2486	14
15	1700	1768	1837	1906	1976	2046	2117	2190	2263	2337	2411	2487	15
16	1701	1769	1838	1907	1977	2047	2119	2191	2264	2338	2413	2489	16
17	1703	1770	1839	1908	1978	2048	2120	2192	2265	2339	2414	2490	17
18	1704	1772	1840	1909	1979	2050	2121	2193	2266	2340	2415	2491	18
19	1705	1773	1841	1910	1980	2051	2122	2194	2268	2342	2416	2492	19
20	1706	1774	1842	1912	1981	2052	2123	2196	2269	2343	2418	2494	20
21	1707	1775	1843	1913	1983	2053	2125	2197	2270	2344	2419	2495	21
22	1708	1776	1845	1914	1984	2054	2126	2198	2271	2345	2420	2496	22
23	1709	1777	1846	1915	1985	2056	2127	2199	2272	2346	2422	2498	23
24	1711	1778	1847	1916	1986	2057	2128	2200	2274	2348	2423	2499	24
25	1712	1780	1848	1917	1987	2058	2129	2202	2275	2349	2424	2500	25
26	1713	1781	1849	1918	1988	2059	2131	2203	2276	2350	2425	2501	26
27	1714	1782	1850	1920	1990	2060	2132	2204	2277	2351	2427	2503	27
28	1715	1783	1852	1921	1991	2061	2133	2205	2279	2353	2428	2504	28
29	1716	1784	1853	1922	1992	2063	2134	2207	2280	2354	2429	2505	29
30	1717	1785	1854	1923	1993	2064	2135	2208	2281	2355	2430	2506	30
31	1718	1786	1855	1924	1994	2065	2137	2209	2282	2356	2432	2508	31
32	1720	1787	1856	1925	1995	2066	2138	2210	2283	2358	2433	2509	32
33	1721	1789	1857	1927	1997	2067	2139	2211	2285	2359	2434	2510	33
34	1722	1790	1858	1928	1998	2069	2140	2213	2286	2360	2435	2512	34
35	1723	1791	1860	1929	1999	2070	2141	2214	2287	2361	2437	2513	35
36	1724	1792	1861	1930	2000	2071	2143	2215	2288	2363	2438	2514	36
37	1725	1793	1862	1931	2001	2072	2144	2216	2290	2364	2439	2515	37
38	1726	1794	1863	1932	2002	2073	2145	2217	2291	2365	2440	2517	38
39	1727	1795	1864	1934	2004	2075	2146	2219	2292	2366	2442	2518	39
40	1729	1797	1865	1935	2005	2076	2147	2220	2293	2368	2443	2519	40
41	1730	1798	1866	1936	2006	2077	2149	2221	2295	2369	2444	2521	41
42	1731	1799	1868	1937	2007	2078	2150	2222	2296	2370	2445	2522	42
43	1732	1800	1869	1938	2008	2079	2151	2224	2297	2371	2447	2523	43
44	1733	1801	1870	1939	2010	2080	2152	2225	2298	2373	2448	2524	44
45	1734	1802	1871	1941	2011	2082	2153	2226	2299	2374	2449	2526	45
46	1735	1803	1872	1942	2012	2083	2155	2227	2301	2375	2451	2527	46
47	1736	1805	1873	1943	2013	2084	2156	2228	2302	2376	2452	2528	47
48	1738	1806	1875	1944	2014	2085	2157	2230	2303	2378	2453	2530	48
49	1739	1807	1876	1945	2015	2086	2158	2231	2304	2379	2454	2531	49
50	1740	1808	1877	1946	2017	2088	2159	2232	2306	2380	2456	2532	50
51	1741	1809	1878	1948	2018	2089	2161	2233	2307	2381	2457	2533	51
52	1742	1810	1879	1949	2019	2090	2162	2235	2308	2383	2458	2535	52
53	1743	1811	1880	1950	2020	2091	2163	2236	2309	2384	2459	2536	53
54	1744	1813	1881	1951	2021	2092	2164	2237	2311	2385	2461	2537	54
55	1746	1814	1883	1952	2022	2094	2165	2238	2312	2386	2462	2538	55
56	1747	1815	1884	1953	2024	2095	2167	2239	2313	2388	2463	2540	56
57	1748	1816	1885	1955	2025	2096	2168	2241	2314	2389	2464	2541	57
58	1749	1817	1886	1956	2026	2097	2169	2242	2316	2390	2466	2542	58
59	1750	1818	1887	1957	2027	2098	2170	2243	2317	2391	2467	2544	59
M	27°	28°	29°	30°	31°	32°	33°	34°	35°	36°	37°	38°	M

TABLE III.

MERIDIONAL PARTS.

M	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	M
0	2545	2623	2702	2782	2863	2946	3030	3116	3203	3292	3382	3474	0
1	2546	2624	2703	2783	2864	2947	3031	3117	3204	3293	3384	3476	1
2	2548	2625	2704	2784	2866	2949	3033	3118	3206	3295	3385	3478	2
3	2549	2627	2706	2786	2867	2950	3034	3120	3207	3296	3387	3479	3
4	2550	2628	2707	2787	2869	2951	3036	3121	3209	3298	3388	3481	4
5	2551	2629	2708	2788	2870	2953	3037	3123	3210	3299	3390	3482	5
6	2553	2631	2710	2790	2871	2954	3038	3124	3212	3301	3391	3484	6
7	2554	2632	2711	2791	2873	2956	3040	3126	3213	3302	3393	3485	7
8	2555	2633	2712	2792	2874	2957	3041	3127	3214	3303	3394	3487	8
9	2557	2634	2714	2794	2875	2958	3043	3129	3216	3305	3396	3488	9
10	2558	2636	2715	2795	2877	2960	3044	3130	3217	3306	3397	3490	10
11	2559	2637	2716	2797	2878	2961	3046	3131	3219	3308	3399	3492	11
12	2560	2638	2718	2798	2880	2963	3047	3133	3220	3309	3400	3493	12
13	2562	2640	2719	2799	2881	2964	3048	3134	3222	3311	3402	3495	13
14	2563	2641	2720	2801	2882	2965	3050	3136	3223	3312	3403	3496	14
15	2564	2642	2722	2802	2884	2967	3051	3137	3225	3314	3405	3498	15
16	2566	2644	2723	2803	2885	2968	3053	3139	3226	3316	3407	3499	16
17	2567	2645	2724	2805	2886	2970	3054	3140	3228	3317	3408	3501	17
18	2568	2646	2726	2806	2888	2971	3055	3142	3229	3319	3410	3503	18
19	2569	2648	2727	2807	2889	2972	3057	3143	3231	3320	3411	3504	19
20	2571	2649	2728	2809	2891	2974	3058	3144	3232	3322	3413	3506	20
21	2572	2650	2729	2810	2892	2975	3060	3146	3234	3323	3414	3507	21
22	2573	2651	2731	2811	2893	2976	3061	3147	3235	3325	3416	3509	22
23	2575	2653	2732	2813	2895	2978	3063	3149	3237	3326	3417	3510	23
24	2576	2654	2733	2814	2896	2979	3064	3150	3238	3328	3419	3512	24
25	2577	2655	2735	2815	2897	2981	3065	3152	3240	3329	3420	3514	25
26	2578	2657	2736	2817	2899	2982	3067	3153	3241	3331	3422	3515	26
27	2580	2658	2737	2818	2900	2983	3068	3155	3242	3332	3423	3517	27
28	2581	2659	2739	2820	2902	2985	3070	3156	3244	3334	3425	3518	28
29	2582	2661	2740	2821	2903	2986	3071	3157	3245	3335	3427	3520	29
30	2584	2662	2742	2822	2904	2988	3073	3159	3247	3337	3428	3521	30
31	2585	2663	2743	2824	2906	2989	3074	3160	3248	3338	3430	3523	31
32	2586	2665	2744	2825	2907	2991	3075	3162	3250	3340	3431	3525	32
33	2588	2666	2746	2826	2908	2992	3077	3163	3251	3341	3433	3526	33
34	2589	2667	2747	2828	2910	2993	3078	3165	3253	3343	3434	3528	34
35	2590	2669	2748	2829	2911	2995	3080	3166	3254	3344	3436	3529	35
36	2591	2670	2750	2830	2913	2996	3081	3168	3256	3346	3437	3531	36
37	2593	2671	2751	2832	2914	2998	3083	3169	3257	3347	3439	3532	37
38	2594	2673	2752	2833	2915	2999	3084	3171	3259	3349	3440	3534	38
39	2595	2674	2754	2834	2917	3000	3085	3172	3260	3350	3442	3536	39
40	2597	2675	2755	2836	2918	3002	3087	3173	3262	3352	3443	3537	40
41	2598	2676	2756	2837	2919	3003	3088	3175	3263	3353	3445	3539	41
42	2599	2678	2758	2839	2921	3005	3090	3176	3265	3355	3447	3540	42
43	2601	2679	2759	2840	2922	3006	3091	3178	3266	3356	3448	3542	43
44	2602	2680	2760	2841	2924	3007	3093	3179	3268	3358	3450	3543	44
45	2603	2682	2762	2843	2925	3009	3094	3181	3269	3359	3451	3545	45
46	2604	2683	2763	2844	2926	3010	3095	3182	3271	3361	3453	3547	46
47	2606	2684	2764	2845	2928	3012	3097	3184	3272	3362	3454	3548	47
48	2607	2686	2766	2847	2929	3013	3098	3185	3274	3364	3456	3550	48
49	2608	2687	2767	2848	2931	3014	3100	3187	3275	3365	3457	3551	49
50	2610	2688	2768	2849	2932	3016	3101	3188	3277	3367	3459	3553	50
51	2611	2690	2770	2851	2933	3017	3103	3190	3278	3368	3460	3555	51
52	2612	2691	2771	2852	2935	3019	3104	3191	3280	3370	3462	3556	52
53	2614	2692	2772	2854	2936	3020	3105	3192	3281	3371	3464	3558	53
54	2615	2694	2774	2855	2937	3021	3107	3194	3283	3373	3465	3559	54
55	2616	2695	2775	2856	2939	3023	3108	3195	3284	3374	3467	3561	55
56	2617	2696	2776	2858	2940	3024	3110	3197	3286	3376	3468	3562	56
57	2619	2698	2778	2859	2942	3026	3111	3198	3287	3378	3470	3564	57
58	2620	2699	2779	2860	2943	3027	3113	3200	3289	3379	3471	3566	58
59	2621	2700	2780	2862	2944	3029	3114	3201	3290	3381	3473	3567	59
M	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	M

TABLE III.

MERIDIONAL PARTS.

M	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°	61°	62°	M
0	3569	3665	3764	3865	3968	4074	4183	4294	4409	4527	4649	4775	0
1	3570	3667	3765	3866	3970	4076	4184	4296	4411	4529	4651	4777	1
2	3572	3668	3767	3868	3971	4077	4186	4298	4413	4531	4653	4779	2
3	3574	3670	3769	3870	3973	4079	4188	4300	4415	4533	4655	4781	3
4	3575	3672	3770	3871	3975	4081	4190	4302	4417	4535	4657	4784	4
5	3577	3673	3772	3873	3977	4083	4192	4304	4419	4537	4660	4786	5
6	3578	3675	3774	3875	3978	4085	4194	4306	4421	4539	4662	4788	6
7	3580	3677	3775	3877	3980	4086	4195	4308	4423	4541	4664	4790	7
8	3582	3678	3777	3878	3982	4088	4197	4309	4425	4543	4666	4792	8
9	3583	3680	3779	3880	3984	4090	4199	4311	4427	4545	4668	4794	9
10	3585	3681	3780	3882	3985	4092	4201	4313	4429	4547	4670	4796	10
11	3586	3683	3782	3883	3987	4094	4203	4315	4431	4549	4672	4798	11
12	3588	3685	3784	3885	3989	4095	4205	4317	4433	4551	4674	4801	12
13	3590	3686	3785	3887	3991	4097	4207	4319	4434	4553	4676	4803	13
14	3591	3688	3787	3889	3992	4099	4208	4321	4436	4555	4678	4805	14
15	3593	3690	3789	3890	3994	4101	4210	4323	4438	4557	4680	4807	15
16	3594	3691	3790	3892	3996	4103	4212	4325	4440	4559	4682	4809	16
17	3596	3693	3792	3894	3998	4104	4214	4327	4442	4562	4684	4811	17
18	3598	3695	3794	3895	3999	4106	4216	4328	4444	4564	4687	4814	18
19	3599	3696	3795	3897	4001	4108	4218	4330	4446	4566	4689	4816	19
20	3601	3698	3797	3899	4003	4110	4220	4332	4448	4568	4691	4818	20
21	3602	3699	3799	3901	4005	4112	4221	4334	4450	4570	4693	4820	21
22	3604	3701	3800	3902	4006	4113	4223	4336	4452	4572	4695	4822	22
23	3606	3703	3802	3904	4008	4115	4225	4338	4454	4574	4697	4824	23
24	3607	3704	3804	3906	4010	4117	4227	4340	4456	4576	4699	4826	24
25	3609	3706	3806	3907	4012	4119	4229	4342	4458	4578	4701	4829	25
26	3610	3708	3807	3909	4014	4121	4231	4344	4460	4580	4703	4831	26
27	3612	3709	3809	3911	4015	4122	4232	4346	4462	4582	4705	4833	27
28	3614	3711	3811	3913	4017	4124	4234	4347	4464	4584	4707	4835	28
29	3615	3713	3812	3914	4019	4126	4236	4349	4466	4586	4710	4837	29
30	3617	3714	3814	3916	4021	4128	4238	4351	4468	4588	4712	4839	30
31	3618	3716	3816	3918	4022	4130	4240	4353	4470	4590	4714	4842	31
32	3620	3717	3817	3919	4024	4132	4242	4355	4472	4592	4716	4844	32
33	3622	3719	3819	3921	4026	4133	4244	4357	4474	4594	4718	4846	33
34	3623	3721	3821	3923	4028	4135	4246	4359	4476	4596	4720	4848	34
35	3625	3722	3822	3925	4029	4137	4247	4361	4478	4598	4722	4850	35
36	3626	3724	3824	3926	4031	4139	4249	4363	4480	4600	4724	4852	36
37	3628	3726	3826	3928	4033	4141	4251	4365	4482	4602	4726	4855	37
38	3630	3727	3827	3930	4035	4142	4253	4367	4484	4604	4728	4857	38
39	3631	3729	3829	3932	4037	4144	4255	4369	4486	4606	4731	4859	39
40	3633	3731	3831	3933	4038	4146	4257	4370	4488	4608	4733	4861	40
41	3634	3732	3832	3935	4040	4148	4259	4372	4490	4610	4735	4863	41
42	3636	3734	3834	3937	4042	4150	4260	4374	4492	4612	4737	4865	42
43	3638	3736	3836	3938	4044	4152	4262	4376	4494	4614	4739	4868	43
44	3639	3737	3838	3940	4045	4153	4264	4378	4495	4616	4741	4870	44
45	3641	3739	3839	3942	4047	4155	4266	4380	4497	4618	4743	4872	45
46	3643	3741	3841	3944	4049	4157	4268	4382	4499	4620	4745	4874	46
47	3644	3742	3843	3945	4051	4159	4270	4384	4501	4623	4747	4876	47
48	3646	3744	3844	3947	4052	4161	4272	4386	4503	4625	4750	4879	48
49	3647	3746	3846	3949	4054	4162	4274	4388	4505	4627	4752	4881	49
50	3649	3747	3848	3951	4056	4164	4275	4390	4507	4629	4754	4883	50
51	3651	3749	3849	3952	4058	4166	4277	4392	4509	4631	4756	4885	51
52	3652	3750	3851	3954	4060	4168	4279	4394	4511	4633	4758	4887	52
53	3654	3752	3853	3956	4061	4170	4281	4396	4513	4635	4760	4890	53
54	3655	3754	3854	3958	4063	4172	4283	4398	4515	4637	4762	4892	54
55	3657	3755	3856	3959	4065	4173	4285	4399	4517	4639	4764	4894	55
56	3659	3757	3858	3961	4067	4175	4287	4401	4519	4641	4766	4896	56
57	3660	3759	3860	3963	4069	4177	4289	4403	4521	4643	4769	4898	57
58	3662	3760	3861	3964	4070	4179	4291	4405	4523	4645	4771	4901	58
59	3664	3762	3863	3966	4072	4181	4292	4407	4525	4647	4773	4903	59
M	51°	52°	53°	54°	55°	56°	57°	58°	59°	60°	61°	62°	M

TABLE III.

MERIDIONAL PARTS.

M	63°	64°	65°	66°	67°	68°	69°	70°	71°	72°	73°	74°	M
0	4905	5039	5179	5324	5474	5631	5795	5966	6146	6335	6534	6746	0
1	4907	5042	5181	5326	5477	5633	5797	5969	6149	6338	6538	6749	1
2	4909	5044	5184	5328	5479	5636	5800	5972	6152	6341	6541	6753	2
3	4912	5046	5186	5331	5482	5639	5803	5975	6155	6345	6545	6757	3
4	4914	5049	5188	5333	5484	5642	5806	5978	6158	6348	6548	6760	4
5	4916	5051	5191	5336	5487	5644	5809	5981	6161	6351	6552	6764	5
6	4918	5053	5193	5338	5489	5647	5811	5984	6164	6354	6555	6768	6
7	4920	5055	5195	5341	5492	5650	5814	5986	6167	6358	6558	6771	7
8	4923	5058	5198	5343	5495	5652	5817	5989	6170	6361	6562	6775	8
9	4925	5060	5200	5346	5497	5655	5820	5992	6173	6364	6565	6779	9
10	4927	5062	5203	5348	5500	5658	5823	5995	6177	6367	6569	6782	10
11	4929	5065	5205	5351	5502	5660	5825	5998	6180	6371	6572	6786	11
12	4931	5067	5207	5353	5505	5663	5828	6001	6183	6374	6576	6790	12
13	4934	5069	5210	5356	5507	5666	5831	6004	6186	6377	6579	6793	13
14	4936	5071	5212	5358	5510	5668	5834	6007	6189	6380	6583	6797	14
15	4938	5074	5214	5361	5513	5671	5837	6010	6192	6384	6586	6801	15
16	4940	5076	5217	5363	5515	5674	5839	6013	6195	6387	6590	6804	16
17	4943	5078	5219	5366	5518	5676	5842	6016	6198	6390	6593	6808	17
18	4945	5081	5222	5368	5520	5679	5845	6019	6201	6394	6597	6812	18
19	4947	5083	5224	5371	5523	5682	5848	6022	6205	6397	6600	6815	19
20	4949	5085	5226	5373	5526	5685	5851	6025	6208	6400	6603	6819	20
21	4951	5088	5229	5376	5528	5687	5854	6028	6211	6403	6607	6823	21
22	4954	5090	5231	5378	5531	5690	5856	6031	6214	6407	6610	6826	22
23	4956	5092	5234	5380	5533	5693	5859	6034	6217	6410	6614	6830	23
24	4958	5095	5236	5383	5536	5695	5862	6037	6220	6413	6617	6834	24
25	4960	5097	5238	5385	5539	5698	5865	6040	6223	6417	6621	6838	25
26	4963	5099	5241	5388	5541	5701	5868	6043	6226	6420	6624	6841	26
27	4965	5102	5243	5390	5544	5704	5871	6046	6230	6423	6628	6845	27
28	4967	5104	5246	5393	5546	5706	5874	6049	6233	6427	6631	6849	28
29	4969	5106	5248	5395	5549	5709	5876	6052	6236	6430	6635	6853	29
30	4972	5108	5250	5398	5552	5712	5879	6055	6239	6433	6639	6856	30
31	4974	5111	5253	5401	5554	5715	5882	6058	6242	6437	6642	6860	31
32	4976	5113	5255	5403	5557	5717	5885	6061	6245	6440	6646	6864	32
33	4978	5115	5258	5406	5559	5720	5888	6064	6249	6443	6649	6868	33
34	4981	5118	5260	5408	5562	5723	5891	6067	6252	6447	6653	6871	34
35	4983	5120	5263	5411	5565	5725	5894	6070	6255	6450	6656	6875	35
36	4985	5122	5265	5413	5567	5728	5896	6073	6258	6453	6660	6879	36
37	4987	5125	5267	5416	5570	5731	5899	6076	6261	6457	6663	6883	37
38	4990	5127	5270	5418	5573	5734	5902	6079	6264	6460	6667	6886	38
39	4992	5129	5272	5421	5575	5736	5905	6082	6268	6463	6670	6890	39
40	4994	5132	5275	5423	5578	5739	5908	6085	6271	6467	6674	6894	40
41	4996	5134	5277	5426	5580	5742	5911	6088	6274	6470	6677	6898	41
42	4999	5136	5280	5428	5583	5745	5914	6091	6277	6473	6681	6901	42
43	5001	5139	5282	5431	5586	5747	5917	6094	6280	6477	6685	6905	43
44	5003	5141	5284	5433	5588	5750	5919	6097	6283	6480	6688	6909	44
45	5005	5143	5287	5436	5591	5753	5922	6100	6287	6483	6692	6913	45
46	5008	5146	5289	5438	5594	5756	5925	6103	6290	6487	6695	6917	46
47	5010	5148	5292	5441	5596	5758	5928	6106	6293	6490	6699	6920	47
48	5012	5151	5294	5443	5599	5761	5931	6109	6296	6494	6702	6924	48
49	5014	5153	5297	5446	5602	5764	5934	6112	6299	6497	6706	6928	49
50	5017	5155	5299	5448	5604	5767	5937	6115	6303	6500	6710	6932	50
51	5019	5158	5301	5451	5607	5770	5940	6118	6306	6504	6713	6936	51
52	5021	5160	5304	5454	5610	5772	5943	6121	6309	6507	6717	6940	52
53	5023	5162	5306	5456	5612	5775	5946	6124	6312	6511	6720	6943	53
54	5026	5165	5309	5459	5615	5778	5948	6127	6315	6514	6724	6947	54
55	5028	5167	5311	5461	5617	5781	5951	6130	6319	6517	6728	6951	55
56	5030	5169	5314	5464	5620	5783	5954	6133	6322	6521	6731	6955	56
57	5033	5172	5316	5466	5623	5786	5957	6136	6325	6524	6735	6959	57
58	5035	5174	5319	5469	5625	5789	5960	6140	6328	6528	6738	6963	58
59	5037	5176	5321	5471	5628	5792	5963	6143	6332	6531	6742	6966	59
M	63°	64°	65°	66°	67°	68°	69°	70°	71°	72°	73°	74°	M

TABLE III.

MERIDIONAL PARTS.

M	75°	76°	77°	78°	79°	80°	81°	82°	83°	84°	85°	86°	M
0	6970	7210	7467	7745	8046	8375	8739	9145	9606	10137	10765	11533	0
1	6974	7214	7472	7749	8051	8381	8745	9153	9614	10147	10776	11547	1
2	6978	7218	7476	7754	8056	8387	8752	9160	9622	10156	10788	11561	2
3	6982	7222	7481	7759	8061	8393	8758	9167	9631	10166	10799	11576	3
4	6986	7227	7485	7764	8067	8398	8765	9174	9639	10175	10811	11590	4
5	6990	7231	7490	7769	8072	8404	8771	9182	9647	10185	10823	11605	5
6	6994	7235	7494	7774	8077	8410	8778	9189	9655	10195	10834	11620	6
7	6997	7239	7498	7778	8083	8416	8784	9196	9664	10205	10846	11634	7
8	7001	7243	7503	7783	8088	8422	8791	9203	9672	10214	10858	11649	8
9	7005	7247	7507	7788	8093	8427	8797	9211	9680	10224	10870	11664	9
10	7009	7252	7512	7793	8099	8433	8804	9218	9689	10234	10881	11679	10
11	7013	7256	7516	7798	8104	8439	8810	9225	9697	10244	10893	11694	11
12	7017	7260	7521	7803	8109	8445	8817	9233	9706	10254	10905	11709	12
13	7021	7264	7525	7808	8115	8451	8823	9240	9714	10264	10917	11724	13
14	7025	7268	7530	7813	8120	8457	8830	9248	9723	10274	10929	11739	14
15	7029	7273	7535	7817	8125	8463	8836	9255	9731	10284	10941	11755	15
16	7033	7277	7539	7822	8131	8469	8843	9262	9740	10294	10953	11770	16
17	7037	7281	7544	7827	8136	8474	8849	9270	9748	10304	10965	11785	17
18	7041	7285	7548	7832	8141	8480	8856	9277	9757	10314	10978	11801	18
19	7045	7289	7553	7837	8147	8486	8863	9285	9765	10324	10990	11816	19
20	7048	7294	7557	7842	8152	8492	8869	9292	9774	10334	11002	11832	20
21	7052	7298	7562	7847	8158	8498	8876	9300	9783	10344	11014	11848	21
22	7056	7302	7566	7852	8163	8504	8883	9307	9791	10354	11027	11863	22
23	7060	7306	7571	7857	8168	8510	8889	9315	9800	10364	11039	11879	23
24	7064	7311	7576	7862	8174	8516	8896	9322	9809	10374	11052	11895	24
25	7068	7315	7580	7867	8179	8522	8903	9330	9817	10385	11064	11911	25
26	7072	7319	7585	7872	8185	8528	8909	9337	9826	10395	11077	11927	26
27	7076	7323	7589	7877	8190	8534	8916	9345	9835	10405	11089	11943	27
28	7080	7328	7594	7882	8196	8540	8923	9353	9844	10416	11102	11959	28
29	7084	7332	7599	7887	8201	8546	8930	9360	9852	10426	11115	11976	29
30	7088	7336	7603	7892	8207	8552	8936	9368	9861	10437	11127	11992	30
31	7092	7341	7608	7897	8212	8558	8943	9376	9870	10447	11140	12008	31
32	7096	7345	7612	7902	8218	8565	8950	9383	9879	10457	11153	12025	32
33	7100	7349	7617	7907	8223	8571	8957	9391	9888	10468	11166	12041	33
34	7104	7353	7622	7912	8229	8577	8963	9399	9897	10478	11179	12058	34
35	7108	7358	7626	7917	8234	8583	8970	9407	9906	10489	11192	12075	35
36	7112	7362	7631	7922	8240	8589	8977	9415	9915	10500	11205	12092	36
37	7116	7366	7636	7927	8245	8595	8984	9422	9924	10510	11218	12109	37
38	7120	7371	7640	7932	8251	8601	8991	9430	9933	10521	11231	12126	38
39	7124	7375	7645	7937	8256	8607	8998	9437	9942	10532	11244	12143	39
40	7128	7379	7650	7942	8262	8614	9005	9445	9951	10542	11257	12160	40
41	7132	7384	7654	7948	8267	8620	9012	9453	9960	10553	11270	12177	41
42	7136	7388	7659	7953	8273	8626	9018	9461	9969	10564	11284	12194	42
43	7140	7392	7664	7958	8279	8632	9025	9469	9978	10575	11297	12212	43
44	7145	7397	7668	7963	8284	8638	9032	9477	9987	10586	11310	12229	44
45	7149	7401	7673	7968	8290	8644	9039	9485	9996	10597	11324	12247	45
46	7153	7406	7678	7973	8295	8651	9046	9493	10005	10608	11338	12265	46
47	7157	7410	7683	7978	8301	8657	9053	9501	10015	10619	11351	12282	47
48	7161	7414	7687	7983	8307	8663	9060	9509	10024	10630	11365	12300	48
49	7165	7419	7692	7989	8312	8669	9067	9517	10033	10641	11378	12318	49
50	7169	7423	7697	7994	8318	8676	9074	9525	10043	10652	11392	12336	50
51	7173	7427	7702	7999	8324	8682	9081	9533	10052	10663	11406	12354	51
52	7177	7432	7706	8004	8329	8688	9088	9541	10061	10674	11420	12373	52
53	7181	7436	7711	8009	8335	8695	9096	9549	10071	10685	11434	12391	53
54	7185	7441	7716	8014	8341	8701	9103	9557	10080	10696	11448	12409	54
55	7189	7445	7721	8020	8347	8707	9110	9565	10089	10708	11462	12428	55
56	7194	7449	7725	8025	8352	8714	9117	9573	10099	10719	11476	12446	56
57	7198	7454	7730	8030	8358	8720	9124	9581	10108	10730	11490	12465	57
58	7202	7458	7735	8035	8364	8726	9131	9589	10118	10742	11504	12484	58
59	7206	7463	7740	8040	8369	8733	9138	9597	10127	10753	11518	12503	59
M	75°	76°	77°	78°	79°	80°	81°	82°	83°	84°	85°	86°	M

TABLE III.

MERIDIONAL PARTS.

M	87°	88°	89°
0	12522	13916	16300
1	12541	13945	16357
2	12561	13974	16416
3	12580	14004	16476
4	12599	14033	16537
5	12619	14063	16599
6	12639	14093	16662
7	12659	14123	16726
8	12679	14154	16792
9	12699	14185	16858
10	12719	14216	16926
11	12739	14247	16996
12	12759	14279	17067
13	12780	14311	17139
14	12801	14343	17213
15	12821	14376	17289
16	12842	14409	17366
17	12863	14442	17445
18	12885	14475	17526
19	12906	14509	17609
20	12927	14543	17694
21	12949	14578	17781
22	12970	14613	17870
23	12992	14648	17962
24	13014	14684	18056
25	13036	14720	18153
26	13059	14756	18252
27	13081	14793	18355
28	13104	14830	18461
29	13126	14869	18570
30	13149	14906	18683
31	13172	14944	18799
32	13195	14983	18920
33	13219	15022	19045
34	13242	15062	19174
35	13266	15102	19309
36	13290	15143	19450
37	13314	15184	19596
38	13338	15226	19749
39	13362	15268	19909
40	13386	15311	20076
41	13411	15354	20253
42	13436	15398	20439
43	13461	15442	20635
44	13486	15487	20844
45	13511	15532	21065
46	13537	15579	21303
47	13563	15625	21557
48	13589	15673	21833
49	13615	15726	22132
50	13641	15779	22459
51	13668	15819	22822
52	13695	15869	23226
53	13722	15920	23685
54	13749	15972	24215
55	13776	16024	24842
56	13804	16078	25609
57	13832	16132	26598
58	13860	16187	27992
59	13888	16243	30375
M	87°	88°	89°

TABLE III.*

CORRECTION OF THE MEAN REFRACTION.

App. Alt.		Height of the Thermometer.										
		20°	26°	32°	38°	44°	50°	56°	62°	68°	74°	80°
°		+″	+″	+″	+″	+″	″	−″	−″	−″	−″	−″
2	0	91	72	53	35	17	0	16	32	48	63	78
2	10	87	68	50	33	16	0	16	31	46	60	74
2	20	83	65	48	32	16	0	15	30	44	58	71
2	30	80	63	46	30	15	0	15	29	43	56	68
2	40	77	60	44	29	14	0	14	28	41	54	66
2	50	74	58	43	28	14	0	13	27	40	52	64
3	0	71	56	41	27	13	0	13	26	38	50	61
3	10	68	54	40	26	13	0	12	25	37	48	59
3	20	66	52	38	25	13	0	12	24	35	46	57
3	30	64	50	37	24	12	0	11	23	34	45	55
3	40	62	49	36	24	12	0	11	22	33	43	53
3	50	60	47	35	23	11	0	10	21	31	42	52
4	0	58	45	33	22	11	0	10	20	30	40	50
4	30	53	42	31	21	10	0	9	19	28	37	45
5	0	48	38	28	18	9	0	9	17	26	33	40
5	30	45	35	26	17	8	0	8	16	24	31	38
6	0	41	32	24	16	8	0	7	15	22	29	35
6	30	38	30	22	14	7	0	7	14	20	27	33
7	0	36	28	21	14	7	0	6	13	19	25	31
7	30	34	27	20	13	6	0	6	12	18	24	29
8	0	32	25	19	12	6	0	5	11	16	22	27
8	30	30	23	17	11	6	0	5	10	15	20	25
9	0	28	22	16	10	5	0	5	10	14	19	24
9	30	27	21	16	10	5	0	5	10	14	19	23
10	0	26	20	15	10	5	0	4	9	13	18	22
10	30	24	19	15	10	5	0	4	9	13	17	21
11	0	23	18	14	9	5	0	4	8	12	16	20
11	30	22	17	13	9	4	0	4	8	12	16	19
12	0	21	17	13	8	4	0	4	8	11	15	18
13	0	20	16	12	8	4	0	3	7	10	14	17
14	0	18	14	11	7	4	0	3	6	9	13	16
15	0	17	13	10	6	3	0	3	6	9	12	15
16	0	16	12	9	6	3	0	3	6	8	11	14
17	0	15	12	9	6	3	0	3	6	8	11	13
18	0	14	11	8	5	3	0	2	5	7	10	12
19	0	13	10	8	5	3	0	2	5	7	9	11
20	0	13	10	7	4	2	0	2	4	6	9	11
21	0	12	9	7	4	2	0	2	4	6	8	10
22	0	11	9	7	4	2	0	2	4	6	8	10
23	0	11	8	6	4	2	0	2	4	6	7	9
24	0	10	8	6	4	2	0	2	4	5	7	9
25	0	10	8	6	4	2	0	2	4	5	7	8
26	0	9	8	6	4	2	0	2	4	5	7	8
27	0	9	7	5	3	2	0	2	3	5	6	8
28	0	9	7	5	3	2	0	1	3	5	6	7
29	0	8	6	5	3	2	0	1	3	4	6	7
30	0	8	6	5	3	2	0	1	2	4	5	7
32	0	7	5	4	2	1	0	1	2	4	5	6
34	0	7	5	4	2	1	0	1	2	3	5	6
36	0	6	5	4	2	1	0	1	2	3	4	5
38	0	6	5	4	2	1	0	1	2	3	4	5
40	0	6	4	3	2	1	0	1	2	3	4	5
45	0	5	4	3	2	1	0	1	1	2	3	4
50	0	4	3	2	1	1	0	1	1	2	3	3
55	0	3	3	2	1	1	0	1	1	2	2	3
60	0	3	2	2	1	1	0	0	1	1	2	2
65	0	2	2	1	1	0	0	0	0	1	[illegible]	2
70	0	2	1	1	0	0	0	0	0	1	1	1
80	0	1	1	0	0	0	0	0	0	0	1	1
90	0	0	0	0	0	0	0	0	0	0	0	0
				− 28.3	− 28.7	− 29.2	29.6	+ 30.0	+ 30.5	+ 30.9		

Height of the Barometer.

TABLE IV.

MEAN REFRACTION.

App. Alt.		Refr.		App. Alt.		Refr.		App. Alt.		Refr.		App. Alt.		Refr.		App. Alt.		Refr.	
°	′	′	″	°	′	′	″	°	′	′	″	°	′	′	″	°	′	′	″
0	0	33	0	5	0	9	54	10	0	5	15	20	0	2	35	34	0	1	24
0	5	32	10	5	5	9	46	10	10	5	10	20	10	2	34	34	30	1	23
0	10	31	22	5	10	9	38	10	20	5	5	20	20	2	32	35	0	1	21
0	15	30	35	5	15	9	30	10	30	5	0	20	30	2	31	35	30	1	20
0	20	29	50	5	20	9	23	10	40	4	56	20	40	2	29	36	0	1	18
0	25	29	6	5	25	9	15	10	50	4	51	20	50	2	28	36	30	1	17
0	30	28	23	5	30	9	8	11	0	4	47	21	0	2	27	37	0	1	16
0	35	27	41	5	35	9	1	11	10	4	43	21	10	2	26	37	30	1	14
0	40	27	0	5	40	8	54	11	20	4	39	21	20	2	25	38	0	1	13
0	45	26	20	5	45	8	47	11	30	4	34	21	30	2	24	38	30	1	11
0	50	25	42	5	50	8	41	11	40	4	31	21	40	2	23	39	0	1	10
0	55	25	5	5	55	8	34	11	50	4	27	21	50	2	21	39	30	1	9
1	0	24	29	6	0	8	28	12	0	4	23	22	0	2	20	40	0	1	8
1	5	23	54	6	5	8	21	12	10	4	20	22	10	2	19	41	0	1	5
1	10	23	20	6	10	8	15	12	20	4	16	22	20	2	18	42	0	1	3
1	15	22	47	6	15	8	9	12	30	4	13	22	30	2	17	43	0	1	1
1	20	22	15	6	20	8	3	12	40	4	9	22	40	2	16	44	0	0	59
1	25	21	44	6	25	7	57	12	50	4	6	22	50	2	15	45	0	0	57
1	30	21	15	6	30	7	51	13	0	4	3	23	0	2	14	46	0	0	55
1	35	20	46	6	35	7	45	13	10	4	0	23	10	2	13	47	0	0	53
1	40	20	18	6	40	7	40	13	20	3	57	23	20	2	12	48	0	0	51
1	45	19	51	6	45	7	35	13	30	3	54	23	30	2	11	49	0	0	49
1	50	19	25	6	50	7	30	13	40	3	51	23	40	2	10	50	0	0	48
1	55	19	0	6	55	7	25	13	50	3	48	23	50	2	9	51	0	0	46
2	0	18	35	7	0	7	20	14	0	3	45	24	0	2	8	52	0	0	44
2	5	18	11	7	5	7	15	14	10	3	43	24	10	2	7	53	0	0	43
2	10	17	48	7	10	7	11	14	20	3	40	24	20	2	6	54	0	0	41
2	15	17	26	7	15	7	6	14	30	3	38	24	30	2	5	55	0	0	40
2	20	17	4	7	20	7	2	14	40	3	35	24	40	2	4	56	0	0	38
2	25	16	44	7	25	6	57	14	50	3	33	24	50	2	3	57	0	0	37
2	30	16	24	7	30	6	53	15	0	3	30	25	0	2	2	58	0	0	35
2	35	16	4	7	35	6	49	15	10	3	28	25	10	2	1	59	0	0	34
2	40	15	45	7	40	6	45	15	20	3	26	25	20	2	0	60	0	0	33
2	45	15	27	7	45	6	41	15	30	3	24	25	30	1	59	61	0	0	32
2	50	15	9	7	50	6	37	15	40	3	21	25	40	1	58	62	0	0	30
2	55	14	52	7	55	6	33	15	50	3	19	25	50	1	57	63	0	0	29
3	0	14	36	8	0	6	29	16	0	3	17	26	0	1	56	64	0	0	28
3	5	14	20	8	5	6	25	16	10	3	15	26	10	1	55	65	0	0	26
3	10	14	4	8	10	6	22	16	20	3	12	26	20	1	55	66	0	0	25
3	15	13	49	8	15	6	18	16	30	3	10	26	30	1	54	67	0	0	24
3	20	13	34	8	20	6	15	16	40	3	8	26	40	1	53	68	0	0	23
3	25	13	20	8	25	6	11	16	50	3	6	26	50	1	52	69	0	0	22
3	30	13	6	8	30	6	8	17	0	3	4	27	0	1	51	70	0	0	21
3	35	12	53	8	35	6	5	17	10	3	3	27	15	1	50	71	0	0	19
3	40	12	40	8	40	6	1	17	20	3	1	27	30	1	49	72	0	0	18
3	45	12	27	8	45	5	58	17	30	2	59	27	45	1	48	73	0	0	17
3	50	12	15	8	50	5	55	17	40	2	57	28	0	1	47	74	0	0	16
3	55	12	3	8	55	5	52	17	50	2	55	28	15	1	46	75	0	0	15
4	0	11	51	9	0	5	48	18	0	2	54	28	30	1	45	76	0	0	14
4	5	11	40	9	5	5	45	18	10	2	52	28	45	1	44	77	0	0	13
4	10	11	29	9	10	5	42	18	20	2	51	29	0	1	42	78	0	0	12
4	15	11	18	9	15	5	39	18	30	2	49	29	30	1	40	79	0	0	11
4	20	11	8	9	20	5	36	18	40	2	47	30	0	1	38	80	0	0	10
4	25	10	58	9	25	5	34	18	50	2	46	30	30	1	37	81	0	0	9
4	30	10	48	9	30	5	31	19	0	2	44	31	0	1	35	82	0	0	8
4	35	10	39	9	35	5	28	19	10	2	43	31	30	1	33	83	0	0	7
4	40	10	29	9	40	5	25	19	20	2	41	32	0	1	31	84	0	0	6
4	45	10	20	9	45	5	23	19	30	2	40	32	30	1	30	86	0	0	4
4	50	10	11	9	50	5	20	19	40	2	38	33	0	1	28	88	0	0	2
4	55	10	2	9	55	5	18	19	50	2	37	33	30	1	26	90	0	0	0

TABLE V.

Dip of the Horizon.

Height.	Dip.	
Feet	′	″
1	0	58
2	1	21
3	1	40
4	1	56
5	2	9
6	2	21
7	2	33
8	2	44
9	2	53
10	3	2
11	3	10
12	3	19
13	3	27
14	3	36
15	3	42
16	3	50
17	3	57
18	4	4
19	4	11
20	4	17
21	4	23
22	4	30
23	4	36
24	4	42
26	4	52
28	5	5
30	5	15
35	5	39
40	6	4
45	6	27
50	6	46
60	7	25
70	8	1
80	8	34
90	9	6
100	9	35

TABLE VI.

Sun's Parallax in Alt.

Altit.	Parall.
°	″
0	9
10	9
20	8
30	8
40	7
50	6
55	5
60	4
65	4
70	3
75	2
80	2
85	1
90	0

TAB. VII.

Moon's Augmentat.

Alt.	Augm.
°	″
0	0
5	1
10	3
15	4
20	6
25	7
30	8
35	9
40	10
45	11
50	12
55	13
60	14
70	15
80	15
90	16

TABLE VIII.

Dip at differ. Distances from the Observer.

Miles.	Height of the Eye in Feet.					
	5	10	15	20	25	30
¼	11′	23′	34′	45′	57′	68′
½	6	12	17	23	28	34
¾	4	8	12	15	19	23
1	3	6	9	12	15	17
1¼	3	5	7	10	12	14
1½	3	4	6	8	10	12
2	2	4	5	7	8	9
2½	2	3	4	6	7	8
3	2	3	4	5	6	7
3½	2	3	4	5	6	6
4	2	3	4	5	5	6
5	2	3	4	4	5	6
6	2	3	4	4	5	5

TABLE IX.

For correcting the OBSERVED ALTITUDE of the SUN'S LOWER LIMB, when taken by a Fore Observation.

Obs. Alt.	Height of the Eye above the Sea in feet.															
	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36
5° 0′	3′.8	3′.5	3′.1	2′.8	2′.5	2′.3	2′.1	1′.8	1′.6	1′.4	1′.2	1′.0	0′.8	0′.6	0′.5	0′.3
5 20	4.3	4.0	3.6	3.3	3.1	2.8	2.6	2.3	2.1	1.9	1.7	1.5	1.3	1.1	1.0	0.8
5 40	4.8	4.5	4.1	3.8	3.5	3.3	3.1	2.8	2.6	2.4	2.2	2.0	1.8	1.6	1.5	1.3
6 0	5.3	4.9	4.6	4.3	4.0	3.7	3.5	3.3	3.0	2.8	2.6	2.4	2.2	2.1	1.9	1.7
6 20	5.7	5.4	5.0	4.7	4.4	4.1	3.9	3.7	3.3	3.2	3.0	2.8	2.6	2.5	2.3	2.0
6 40	6.0	5.7	5.3	5.0	4.7	4.5	4.3	4.0	3.8	3.6	3.4	3.2	3.0	2.8	2.7	2.3
7 0	6.4	6.0	5.7	5.4	5.1	4.8	4.6	4.4	4.1	3.9	3.7	3.5	3.3	3.2	3.0	2.7
7 20	6.7	6.3	6.0	5.7	5.4	5.1	4.9	4.7	4.4	4.2	4.0	3.8	3.6	3.5	3.3	3.1
7 40	6.9	6.6	6.2	5.9	5.7	5.4	5.2	4.9	4.7	4.5	4.3	4.1	3.9	3.8	3.6	3.4
8 0	7.2	6.8	6.5	6.2	5.9	5.7	5.4	5.3	5.0	4.8	4.6	4.4	4.2	4.0	3.9	3.7
8 20	7.5	7.1	6.7	6.5	6.2	5.9	5.7	5.5	5.2	5.0	4.8	4.6	4.4	4.3	4.1	3.9
8 40	7.7	7.3	7.0	6.7	6.4	6.1	5.9	5.7	5.5	5.2	5.0	4.8	4.7	4.5	4.3	4.1
9 0	7.9	7.5	7.2	6.9	6.6	6.4	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.4
9 20	8.1	7.7	7.4	7.1	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.6
9 40	8.3	7.9	7.6	7.3	7.0	6.7	6.5	6.3	6.1	5.8	5.6	5.4	5.3	5.1	4.9	4.7
10 0	8.5	8.1	7.8	7.5	7.2	6.9	6.7	6.5	6.2	6.0	5.8	5.6	5.4	5.3	5.1	4.9
10 30	8.7	8.3	8.0	7.7	7.4	7.2	6.9	6.7	6 5	6.3	6.1	5.9	5.7	5.5	5.4	5.2
11 0	8.9	8.6	8.2	7.9	7.6	7.4	7.2	6.9	6.7	6.5	6.3	6.1	5.9	5.7	5.6	5.4
11 30	9.1	8.8	8.4	8.1	7.8	7.6	7.4	7.1	6.9	6.7	6.5	6.3	6.1	5.9	5.8	5.6
12 0	9.3	9.0	8.7	8.3	8.0	7.8	7.6	7.3	7.1	6.9	6.7	6.5	6.3	6.2	6.0	5.8
13 0	9.6	9.3	9.0	8.7	8.4	8.1	7.9	7.7	7.4	7.2	7.0	6.8	6.6	6.5	6.3	6.1
14 0	9.9	9.6	9.2	8.9	8.7	8.4	8.2	7.9	7.7	7.5	7.3	7.1	6.9	6.8	6.6	6.4
15 0	10.2	9.8	9.5	9.2	8.9	8.7	8.4	8.2	8.0	7.8	7.6	7.4	7.2	7.0	6.9	6.7
16 0	10.4	10.1	9.7	9.4	9.1	8.9	8.7	8.4	8.2	8.0	7.8	7.6	7.4	7.2	7.1	6.9
17 0	10.6	10.3	9.9	9.6	9.3	9.1	8.9	8.6	8.3	8.2	8.0	7.8	7.6	7.4	7.3	7.1
18 0	10.8	10.4	10.1	9.8	9.5	9.3	9.0	8.8	8.6	8.4	8.2	8.0	7.8	7.6	7.5	7.3
19 0	11.0	10.6	10.3	10.0	9.7	9.4	9.2	9.0	8.8	8.5	8.3	8.1	8.0	7.8	7.6	7.4
20 0	11.1	10.7	10.4	10.1	9.8	9.6	9.3	9.1	8.9	8.7	8.5	8.2	8.1	7.9	7.7	7.6
21 0	11.2	10.9	10.5	10.2	10.0	9.7	9.5	9.2	9.0	8.8	8.6	8.4	8.2	8.1	7.9	7.7
22 0	11.4	11.0	10.7	10.4	10.1	9.8	9.6	9.4	9.1	8.9	8.7	8.5	8.3	8.2	8.0	7.8
23 0	11.5	11.1	10.8	10.5	10.2	9.9	9.7	9.5	9.2	9.0	8.8	8.6	8.4	8.3	8.1	7.9
24 0	11.6	11.2	10.9	10.6	10.3	10.0	9.8	9.6	9.3	9.1	8.9	8.7	8.5	8.4	8.2	8.0
25 0	11.7	11.3	11.0	10.7	10.4	10.1	9.9	9.7	9.4	9.2	9.0	8.8	8.6	8.5	8.3	8.1
26 0	11.7	11.4	11.0	10.7	10.5	10.2	10.0	9.7	9.5	9.3	9.1	8.9	8.7	8.6	8.4	8.2
27 0	11.8	11.5	11.1	10.8	10.5	10.3	10.1	9.8	9.6	9.4	9.2	9.0	8.8	8.6	8.5	8.3
28 0	11.9	11.6	11.2	10.9	10.6	10.4	10.2	9.9	9.7	9.5	9.3	9.1	8.9	8.7	8.5	8.4
30 0	12.0	11.7	11.3	11.0	10.8	10.5	10.3	10.0	9.8	9.6	9.4	9.2	9.0	8.9	8.7	8.5
32 0	12.2	11.8	11.5	11.2	10.9	10.6	10.4	10.2	9.9	9.7	9.5	9.3	9.1	9.0	8.8	8.6
34 0	12.3	11.9	11.6	11.3	11.0	10.7	10.5	10.3	10.1	9.9	9.6	9.4	9.2	9.1	8.9	8.7
36 0	12.4	12.0	11.7	11.4	11.1	10.8	10.6	10.4	10.2	9.9	9.7	9.5	9.3	9.2	9.0	8.8
38 0	12.5	12.1	11.8	11.5	11.2	10.9	10.7	10.5	10.2	10.0	9.8	9.6	9.4	9.3	9.1	8.9
40 0	12.5	12.2	11.8	11.5	11.3	11.0	10.8	10.5	10.3	10.1	9.9	9.7	9.5	9.4	9.2	9.0
42 0	12.6	12.2	11.9	11.6	11.3	11.1	10.8	10.6	10.4	10.2	10.0	9.8	9.6	9.4	9.3	9.1
44 0	12.7	12.3	12.0	11.7	11.4	11.1	10.9	10.7	10.5	10.2	10.1	9.8	9.7	9.5	9.3	9.1
46 0	12.7	12.4	12.0	11.7	11.5	11.2	11.0	10.7	10.5	10.3	10.2	9.9	9.7	9.6	9.4	9.2
48 0	12.8	12.4	12.1	11.8	11.5	11.3	11.0	10.8	10.6	10.4	10 2	10.0	9.8	9.6	9.5	9.3
50 0	12.8	12.5	12.2	11.9	11.6	11.3	11.1	10.9	10.6	10.4	10.3	10.0	9.8	9.7	9.5	9.3
52 0	12.9	12.5	12.2	11.9	11.6	11.4	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.7	9.6	9.4
54 0	13.0	12.6	12.3	12.0	11.7	11.4	11.2	11.0	10.7	10.5	10.3	10.1	9.9	9.8	9.6	9.4
56 0	13.0	12.6	12.3	12.0	11.7	11.5	11.2	11.0	10.8	10.6	10.4	10.2	10.0	9.8	9.7	9.5
58 0	13.0	12.7	12.3	12.0	11.7	11.5	11.3	11.0	10.8	10.6	10.4	10.2	10.0	9.9	9.7	9.5
60 0	13.1	12.7	12.4	12.1	11.8	11.6	11.3	11.1	10.9	10.6	10.4	10.2	10.1	9.9	9.7	9.5
62 0	13.1	12.8	12.4	12.1	11.8	11.6	11.4	11.1	10.9	10.7	10.5	10.3	10.1	9.9	9.8	9.6
64 0	13.2	12.8	12.5	12.2	11.9	11.6	11.4	11.2	10.9	10.7	10.5	10.3	10.1	10.0	9.8	9.6
66 0	13.2	12.8	12.5	12.2	11.9	11.7	11.4	11.2	11.0	10.8	10.6	10.4	10.2	10.0	9.8	9.7
70 0	13.3	12.9	12.6	12.3	12.0	11.8	11.5	11.3	11.0	10.8	10.6	10.4	10.2	10.1	9.9	9.7
80 0	13.4	13.1	12.7	12.4	12.1	11.9	11.7	11.4	11.2	11.0	10.8	10.6	10.4	10.2	10.1	9.9
90 0	13.6	13.2	12.9	12.6	12.3	12.0	11.8	11.6	11.3	11.1	10.9	10.7	10.5	10.4	10.2	10.0

Month	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Correct.	+0′.3	+0′.2	+0′.1	0′.0	−0′.2	−0′.2	−0′.3	−0′.2	−0′.1	+0′.1	+0′.2	+0′.3

TABLE X.

SUN'S DECLINATION for the Years 1859, 1863, 1867, 1871, &c.

Days	Jan.		Feb.		March		April.		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Days.
	South.		South.		South.		North.		North.		North.		North.		North.		North.		South.		South.		South.		
	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	
1	23	2	17	10	7	40S.	4	27	15	0	22	2	23	9	18	7	8	24N.	3	5	14	22	21	47	1
2	22	57	16	53	7	17	4	50	15	18	22	10	23	5	17	52	8	2	3	28	14	41	21	57	2
3	22	51	16	35	6	54	5	13	15	36	22	18	23	0	17	36	7	40	3	52	15	0	22	5	3
4	22	45	16	17	6	31	5	36	15	54	22	25	22	55	17	20	7	18	4	15	15	19	22	14	4
5	22	39	15	59	6	8	5	59	16	11	22	32	22	50	17	4	6	56	4	38	15	37	22	22	5
6	22	32	15	41	5	45	6	22	16	28	22	38	22	44	16	48	6	33	5	1	15	55	22	29	6
7	22	25	15	22	5	22	6	44	16	45	22	44	22	39	16	31	6	11	5	24	16	13	22	36	7
8	22	17	15	3	4	58	7	7	17	1	22	50	22	32	16	15	5	48	5	47	16	31	22	43	8
9	22	9	14	44	4	35	7	29	17	13	22	55	22	25	15	57	5	26	6	10	16	48	22	49	9
10	22	0	14	25	4	11	7	52	17	33	23	0	22	18	15	40	5	3	6	33	17	5	22	55	10
11	21	51	14	5	3	48	8	14	17	49	23	5	22	10	15	22	4	40	6	56	17	22	23	0	11
12	21	41	13	46	3	24	8	36	18	4	23	9	22	2	15	5	4	18	7	18	17	39	23	5	12
13	21	31	13	26	3	1	8	58	18	19	23	13	21	54	14	47	3	55	7	41	17	55	23	9	13
14	21	21	13	5	2	37	9	19	18	34	23	16	21	45	14	28	3	32	8	3	18	11	23	13	14
15	21	10	12	45	2	13	9	41	18	49	23	19	21	36	14	10	3	9	8	26	18	26	23	17	15
16	20	59	12	24	1	50	10	2	19	3	23	21	21	26	13	51	2	45	8	48	18	42	23	20	16
17	20	47	12	3	1	26	10	23	19	16	23	23	21	16	13	32	2	22	9	10	18	57	23	22	17
18	20	35	11	42	1	2	10	44	19	30	23	25	21	6	13	13	1	59	9	32	19	11	23	24	18
19	20	23	11	21	0	39	11	5	19	43	23	26	20	55	12	53	1	36	9	54	19	25	23	26	19
20	20	10	11	0	0	15S.	11	26	19	56	23	27	20	44	12	34	1	12	10	15	19	39	23	27	20
21	19	57	10	38	0	9N.	11	46	20	8	23	28	20	33	12	14	0	49	10	37	19	53	23	27	21
22	19	44	10	16	0	32	12	7	20	20	23	28	20	21	11	54	0	26	10	58	20	6	23	28	22
23	19	30	9	54	0	56	12	27	20	32	23	27	20	9	11	33	0	2N.	11	19	20	19	23	27	23
24	19	16	9	32	1	20	12	47	20	44	23	26	19	57	11	13	0	21S.	11	40	20	31	23	26	24
25	19	1	9	10	1	43	13	7	20	55	23	25	19	44	10	52	0	45	12	1	20	43	23	25	25
26	18	46	8	48	2	7	13	26	21	5	23	23	19	31	10	32	1	8	12	22	20	55	23	23	26
27	18	31	8	25	2	30	13	45	21	16	23	21	19	18	10	11	1	31	12	43	21	6	23	21	27
28	18	15	8	3	2	54	14	4	21	26	23	19	19	4	9	50	1	55	13	3	21	17	23	19	28
29	17	59			3	17	14	23	21	35	23	16	18	50	9	28	2	18	13	23	21	28	23	15	29
30	17	43			3	41	14	42	21	44	23	13	18	36	9	7	2	42S.	13	43	21	38	23	12	30
31	17	27			4	4N.			21	53			18	22	8	45			14	2			23	8	31

TABLE XI. TO CORRECT THE SUN'S DECLINATION.

When Declin. is increasing, { add in W. Long. / sub. in E. Long. }

When Declin. is decreasing, { sub. in W. Long. / add in E. Long. }

Long.	SUN'S DECLINATION.																									Long.
	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	23½°	
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	°
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	10
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20
30	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0	30
40	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	40
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	0	50
60	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	1	1	0	60
70	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	0	70
80	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	3	3	2	2	1	0	80
90	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	4	4	4	4	3	3	2	1	0	90
100	7	7	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	4	4	4	3	2	1	0	100
110	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	5	.5	5	4	4	3	3	1	0	110
120	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	4	3	2	0	120
130	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	6	6	6	5	5	4	3	2	0	130
140	9	9	9	9	9	9	9	9	9	9	8	8	8	8	7	7	7	6	6	6	5	4	3	2	0	140
150	10	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	7	7	6	6	5	5	4	2	0	150
160	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	8	8	7	7	6	6	5	4	2	0	160
170	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	8	8	7	7	6	5	4	2	0	170
180	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	9	9	8	8	7	6	5	4	2	0	180

TABLE X.

SUN'S DECLINATION for the Years 1860, 1864, 1868, 1872, &c.

Days	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Days.
	South.	South.	South.	North.	North.	North.	North.	North.	North.	South.	South.	South.	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	23 3	17 14	7 23S.	4 45	15 14	22 8	23 6	17 55	8 7N.	3 23	14 36	21 54	1
2	22 58	16 57	7 0	5 8	15 32	22 16	23 1	17 40	7 45	3 46	14 55	22 3	2
3	22 53	16 39	6 37	5 31	15 49	22 23	22 57	17 24	7 23	4 9	15 14	22 12	3
4	22 47	16 22	6 14	5 53	16 7	22 30	22 51	17 8	7 1	4 32	15 33	22 20	4
5	22 41	16 4	5 51	6 16	16 24	22 37	22 46	16 52	6 39	4 55	15 51	22 27	5
6	22 34	15 45	5 27	6 39	16 41	22 43	22 40	16 35	6 16	5 19	16 9	22 35	6
7	22 27	15 27	5 4	7 1	16 57	22 49	22 33	16 19	5 54	5 42	16 27	22 41	7
8	22 19	15 8	4 41	7 24	17 14	22 54	22 27	16 2	5 31	6 4	16 44	22 48	8
9	22 11	14 49	4 17	7 46	17 30	22 59	22 19	15 44	5 9	6 27	17 1	22 53	9
10	22 2	14 30	3 54	8 8	17 45	23 4	22 12	15 27	4 46	6 50	17 18	22 59	10
11	21 53	14 10	3 30	8 30	18 1	23 8	22 4	15 9	4 23	7 13	17 35	23 4	11
12	21 44	13 51	3 6	8 52	18 16	23 12	21 56	14 51	4 0	7 35	17 51	23 8	12
13	21 34	13 31	2 43	9 14	18 31	23 15	21 47	14 33	3 37	7 58	18 7	23 12	13
14	21 24	13 10	2 19	9 36	18 45	23 18	21 38	14 14	3 14	8 20	18 23	23 16	14
15	21 13	12 50	1 56	9 57	18 59	23 21	21 29	13 55	2 51	8 42	18 38	23 19	15
16	21 2	12 29	1 32	10 18	19 13	23 23	21 19	13 36	2 28	9 5	18 53	23 21	16
17	20 50	12 8	1 8	10 39	19 27	23 25	21 8	13 17	2 5	9 27	19 8	23 24	17
18	20 38	11 47	0 44	11 0	19 40	23 26	20 58	12 58	1 41	9 48	19 22	23 25	18
19	20 26	11 26	0 21S.	11 21	19 53	23 27	20 47	12 38	1 18	10 10	19 36	23 26	19
20	20 14	11 5	0 3N.	11 42	20 5	23 27	20 36	12 18	0 55	10 32	19 50	23 27	20
21	20 0	10 43	0 27	12 2	20 17	23 28	20 24	11 58	0 31	10 53	20 3	23 27	21
22	19 47	10 22	0 50	12 22	20 29	23 27	20 12	11 38	0 8N.	11 14	20 16	23 27	22
23	19 33	10 0	1 14	12 42	20 41	23 26	20 0	11 18	0 16S.	11 35	20 28	23 27	23
24	19 19	9 38	1 38	13 2	20 52	23 25	19 47	10 57	0 39	11 56	20 40	23 25	24
25	19 5	9 15	2 1	13 21	21 3	23 24	19 35	10 37	1 2	12 17	20 52	23 24	25
26	18 50	8 53	2 25	13 41	21 13	23 22	19 21	10 16	1 26	12 38	21 4	23 22	26
27	18 35	8 31	2 48	14 0	21 23	23 19	19 8	9 55	1 49	12 58	21 14	23 19	27
28	18 19	8 8	3 12	14 19	21 33	23 17	18 54	9 34	2 13	13 18	21 25	23 16	28
29	18 3	7 45	3 35	14 37	21 42	23 13	18 40	9 12	2 36	13 38	21 35	23 13	29
30	17 47		3 58	14 56	21 51	23 10	18 25	8 51	2 59S.	13 58	21 45	23 9	30
31	17 31		4 21N.		22 0		18 10	8 29		14 18		23 4	31

TABLE XII. To correct the Sun's Declination.

When Declin. { add in W. Long. }
is increasing, { sub. in E. Long. }

When Declin. { sub. in W. Long. }
is decreasing, { add in E. Long. }

Long.	SUN'S DECLINATION.																									Long.
	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	23½°	
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	°
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	10
20	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20
30	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	0	30
40	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	0	40
50	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	0	50
60	4	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	3	3	3	2	2	2	1	1	0	60
70	5	5	5	5	5	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	2	2	2	1	0	70
80	5	5	5	5	5	5	5	5	5	5	5	5	5	4	4	4	4	4	3	3	3	2	2	1	0	80
90	6	6	6	6	6	6	6	6	6	6	5	5	5	5	5	5	4	4	4	4	3	3	2	1	0	90
100	7	7	6	6	6	6	6	6	6	6	6	6	6	6	5	5	5	5	4	4	4	3	2	1	0	100
110	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	5	5	5	4	4	3	3	1	0	110
120	8	8	8	8	8	8	8	7	7	7	7	7	7	7	6	6	6	6	5	5	4	4	3	2	0	120
130	9	8	8	8	8	8	8	8	8	8	8	8	7	7	7	7	6	6	6	5	5	4	3	2	0	130
140	9	9	9	9	9	9	9	9	9	9	8	8	8	8	7	7	7	6	6	6	5	4	3	2	0	140
150	10	10	10	10	10	10	10	9	9	9	9	9	9	8	8	8	7	7	6	6	5	5	4	2	0	150
160	10	10	10	10	10	10	10	10	10	10	10	9	9	9	9	8	8	7	7	6	6	5	4	2	0	160
170	11	11	11	11	11	11	11	10	10	10	10	10	10	9	9	9	8	8	7	7	6	5	4	2	0	170
180	12	12	12	12	12	12	11	11	11	11	11	11	10	10	10	9	9	8	8	7	6	5	4	2	0	180

TABLE X.

Sun's Declination for the Years 1861, 1865, 1869, 1873, &c.

Days.	Jan.	Feb.	March	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Days.
	South.	South.	South.	North.	North.	North.	North.	North.	North.	South.	South.	South.	
	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	
1	22 59	17 1	7 28S.	4 39	15 9	22 6	23 7	17 59	8 13N.	3 17	14 32	21 52	1
2	22 54	16 43	7 5	5 2	15 27	22 14	23 3	17 44	7 51	3 40	14 51	22 1	2
3	22 48	16 26	6 42	5 25	15 45	22 21	22 58	17 28	7 29	4 4	15 10	22 10	3
4	22 42	16 8	6 19	5 48	16 3	22 28	22 53	17 12	7 7	4 27	15 28	22 18	4
5	22 35	15 50	5 56	6 11	16 20	22 35	22 47	16 56	6 44	4 50	15 47	22 25	5
6	22 28	15 31	5 33	6 33	16 37	22 41	22 41	16 39	6 22	5 13	16 5	22 33	6
7	22 21	15 13	5 10	6 56	16 53	22 47	22 35	16 23	5 59	5 36	16 22	22 40	7
8	22 13	14 54	4 46	7 18	17 10	22 53	22 28	16 6	5 37	5 59	16 40	22 46	8
9	22 4	14 34	4 23	7 41	17 26	22 58	22 21	15 49	5 14	6 22	16 57	22 52	9
10	21 55	14 15	3 59	8 3	17 41	23 3	22 14	15 31	4 51	6 45	17 14	22 57	10
11	21 46	13 55	3 36	8 25	17 57	23 7	22 6	15 13	4 29	7 7	17 31	23 2	11
12	21 36	13 35	3 12	8 47	18 12	23 11	21 58	14 55	4 6	7 30	17 47	23 7	12
13	21 26	13 15	2 48	9 9	18 27	23 14	21 49	14 37	3 43	7 52	18 3	23 11	13
14	21 15	12 55	2 25	9 30	18 42	23 17	21 40	14 19	3 20	8 15	18 19	23 15	14
15	21 4	12 34	2 1	9 52	18 56	23 20	21 31	14 0	2 57	8 37	18 34	23 18	15
16	20 53	12 13	1 37	10 13	19 10	23 22	21 21	13 41	2 33	8 59	18 49	23 21	16
17	20 41	11 52	1 14	10 34	19 23	23 24	21 11	13 22	2 10	9 21	19 4	23 23	17
18	20 29	11 31	0 50	10 55	19 37	23 26	21 0	13 3	1 47	9 43	19 19	23 25	18
19	20 16	11 10	0 26	11 16	19 50	23 27	20 50	12 43	1 24	10 5	19 33	23 26	19
20	20 4	10 48	0 3S.	11 37	20 2	23 27	20 39	12 23	1 0	10 26	19 46	23 27	20
21	19 50	10 27	0 21N.	11 57	20 14	23 27	20 27	12 3	0 37	10 48	20 0	23 27	21
22	19 37	10 5	0 45	12 17	20 26	23 27	20 15	11 43	0 14N.	11 9	20 13	23 27	22
23	19 22	9 43	1 8	12 37	20 38	23 27	20 3	11 23	0 10S.	11 30	20 25	23 27	23
24	19 8	9 21	1 32	12 57	20 49	23 26	19 51	11 2	0 33	11 51	20 37	23 26	24
25	18 53	8 59	1 56	13 17	21 0	23 24	19 38	10 42	0 57	12 12	20 49	23 24	25
26	18 38	8 36	2 19	13 36	21 11	23 22	19 25	10 21	1 20	12 33	21 1	23 22	26
27	18 23	8 14	2 43	13 55	21 21	23 20	19 11	10 0	1 43	12 53	21 12	23 20	27
28	18 7	7 51	3 6	14 14	21 30	23 17	18 57	9 39	2 7	13 13	21 22	23 17	28
29	17 51		3 29	14 33	21 40	23 14	18 43	9 17	2 30	13 33	21 33	23 14	29
30	17 35		3 53	14 51	21 49	23 11	18 29	8 56	2 54S.	13 53	21 43	23 10	30
31	17 18		4 16N.		21 58		18 14	8 34		14 12		23 5	31

TABLE XII.

To correct the Sun's Declination for the Changes in Periods of Four Years.

Periods of Years.	MONTHS.															Periods of Years.
	JANUARY.					FEBRUARY.					MARCH.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	sub. ′	add ′	
4	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	4
8	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	8
12	0	1	1	1	1	1	2	2	2	2	2	2	2	2	2	12
16	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	16
20	1	1	1	2	2	2	3	3	3	3	3	3	3	4	4	20
	APRIL.					MAY.					JUNE.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	add ′	add ′	add ′	add ′	add ′	add ′	add ′	add ′	add ′	add ′	add ′	add ′	add ′	′	′	
4	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	4
8	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	8
12	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	12
16	3	3	3	3	2	2	2	2	2	1	1	1	0	0	0	16
20	4	3	3	3	3	3	3	2	2	2	1	1	1	0	0	20

TABLE X.

SUN'S DECLINATION for the Years 1862, 1866, 1870, 1874, &c.

Days.	Jan.		Feb.		March		April		May.		June.		July.		Aug.		Sept.		Oct.		Nov.		Dec.		Days.
	South.		South.		South.		North.		North.		North.		North		North.		North.		South.		South.		South.		
	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	
1	23	1	17	5	7	34S.	4	33	15	5	22	4	23	8	18	2	8	18N.	3	11	14	27	21	50	1
2	22	55	16	48	7	11	4	56	15	23	22	12	23	3	17	47	7	56	3	35	14	46	21	59	2
3	22	50	16	30	6	48	5	19	15	41	22	19	22	59	17	32	7	34	3	58	15	5	22	8	3
4	22	44	16	12	6	25	5	42	15	58	22	27	22	54	17	16	7	12	4	21	15	24	22	16	4
5	22	37	15	54	6	2	6	5	16	16	22	33	22	48	17	0	6	49	4	44	15	42	22	24	5
6	22	30	15	36	5	38	6	28	16	33	22	40	22	43	16	43	6	27	5	7	16	00	22	31	6
7	22	22	15	17	5	15	6	50	16	49	22	46	22	36	16	27	6	5	5	30	16	18	22	38	7
8	22	15	14	58	4	52	7	13	17	6	22	51	22	30	16	10	5	42	5	53	16	36	22	44	8
9	22	6	14	39	4	28	7	35	17	22	22	57	22	23	15	53	5	20	6	16	16	53	22	50	9
10	21	57	14	20	4	5	7	58	17	38	23	1	22	15	15	35	4	57	6	39	17	10	22	56	10
11	21	48	14	0	3	41	8	20	17	53	23	6	22	8	15	18	4	34	7	2	17	27	23	1	11
12	21	38	13	40	3	18	8	42	18	8	23	10	22	0	15	0	4	11	7	24	17	43	23	6	12
13	21	28	13	20	2	54	9	3	18	23	23	13	21	51	14	41	3	48	7	47	17	59	23	10	13
14	21	18	13	0	2	31	9	25	18	38	23	17	21	42	14	23	3	25	8	9	18	15	23	14	14
15	21	7	12	39	2	7	9	47	18	52	23	19	21	33	14	4	3	2	8	32	18	31	23	17	15
16	20	56	12	19	1	43	10	8	19	6	23	22	21	23	13	46	2	39	8	54	18	46	23	20	16
17	20	44	11	58	1	20	10	29	19	20	23	24	21	13	13	26	2	16	9	16	19	1	23	22	17
18	20	32	11	36	0	56	10	50	19	33	23	25	21	3	13	7	1	52	9	38	19	15	23	24	18
19	20	20	11	15	0	32	11	11	19	46	23	26	20	52	12	47	1	29	10	0	19	29	23	26	19
20	20	7	10	54	0	9S.	11	32	19	59	23	27	20	41	12	28	1	6	10	21	19	43	23	27	20
21	19	54	10	32	0	15N.	11	52	20	11	23	27	20	29	12	8	0	42	10	43	19	56	23	27	21
22	19	40	10	10	0	39	12	12	20	24	23	27	20	18	11	48	0	19N.	11	4	20	10	23	27	22
23	19	26	9	48	1	3	12	32	20	35	23	27	20	6	11	28	0	4S.	11	25	20	22	23	27	23
24	19	12	9	26	1	26	12	52	20	46	23	26	19	53	11	7	0	28	11	46	20	35	23	26	24
25	18	57	9	4	1	50	13	12	20	57	23	24	19	41	10	47	0	51	12	7	20	46	23	25	25
26	18	42	8	42	2	13	13	31	21	8	23	23	19	28	10	26	1	15	12	28	20	58	23	23	26
27	18	27	8	19	2	37	13	50	21	18	23	21	19	14	10	5	1	38	12	48	21	9	23	20	27
28	18	11	7	56	3	0	14	9	21	28	23	18	19	0	9	44	2	1	13	8	21	20	23	18	28
29	17	55			3	24	14	28	21	38	23	15	18	46	9	22	2	25	13	28	21	30	23	14	29
30	17	39			3	47	14	47	21	47	23	12	18	32	9	1	2	48S.	13	48	21	40	23	11	30
31	17	22			4	10N.			21	55			18	17	8	39			14	8			23	6	31

TABLE XII.

To correct the Sun's Declination for the Changes in Periods of Four Years.

Periods of Years.	MONTHS.															Periods of Years.
	JULY.					AUGUST.					SEPTEMBER.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	sub.	add	
	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	
4	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	4
8	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	8
12	0	1	1	1	1	1	2	2	2	2	2	2	2	2	2	12
16	0	1	1	1	2	2	2	2	2	3	3	3	3	3	3	16
20	1	1	1	2	2	2	2	3	3	3	3	3	3	4	4	20
	OCTOBER.					NOVEMBER.					DECEMBER.					
	Days.					Days.					Days.					
	1	7	13	19	25	1	7	13	19	25	1	7	13	19	25	
	add	add	add	add	add	add	add	add	add	add	add	add	add			
	'	'	'	'	'	'	'	'	'	'	'	'	'	'	'	
4	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	4
8	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	8
12	2	2	2	2	2	2	2	1	1	1	1	1	0	0	0	12
16	3	3	3	3	2	2	2	2	2	1	1	1	0	0	0	16
20	3	3	3	3	3	3	3	2	2	2	2	1	1	0	0	20

TABLE XIII.

The Right Ascensions and Declinations of the Principal Fixed Stars, adapted to January 1, 1860.

Charac	Constellations.	Pr. Names.	Magni-tudes.	Right Ascension in Time.			Ann. Var. of R. A.	Declination.				Ann. Var. of Declin.
				h.	m.	s.	s.	°	′	″		″
α	Andromeda	*Alpheratz*	1	0	1	9	+ 3.08	28	19	3	N	+ 19.90
γ	Pegasus	*Algenib*	2.3	0	6	2	+ 3.08	14	24	19	N	+ 20.03
α	Cassiopeia	*Schedar*	Var.	0	32	35	+ 3 36	55	46	8	N	+ 19.81
β	Andromeda	*Mirach*	2	1	1	53	+ 3.31	34	52	34	N	+ 19.36
α	Ursa Minor	*Pole Star*	2.3	1	8	3	+18.84	88	23	47	N	+ 19.18
α	Eridanus	*Achernar*	1	1	32	30	+ 2.24	57	56	57	S.	− 18.43
α	Aries	ARIETIS	3	1	59	17	+ 3.36	22	47	54	N	+ 17.25
α	Cetus	*Menkar*	2.3	2	54	58	+ 3.13	3	32	16	N	+ 14.38
β	Perseus	*Algol*	Var.	2	59	2	+ 3.85	40	24	51	N	+ 14.35
α	Perseus		2.3	3	14	21	+ 4.24	49	21	33	N	+ 3.22
α	Taurus	ALDEBARAN	1	4	27	53	+ 3.43	16	13	28	N	+ 7.67
α	Auriga	*Capella*	1	5	6	21	+ 4.42	45	51	3	N	+ 4.20
β	Orion	*Rigel*	1	5	7	49	+ 2.88	8	22	0	S.	− 4.50
β	Taurus		2	5	17	27	+ 3 79	28	29	6	N	+ 3.50
γ	Orion	*Bellatrix*	2	5	17	38	+ 3.21	6	13	11	N	+ 3.82
δ	Orion		2	5	24	51	+ 3.07	0	24	23	S.	− 3.02
ε	Orion		2.3	5	29	7	+ 3.04	1	17	41	S.	− 2.68
α	Columba		2	5	34	35	+ 2.18	34	9	2	S.	− 2.22
α	Orion	*Betelguese*	1	5	47	36	+ 3.25	7	22	38	N	+ 1.08
α	Argo	*Canopus*	1	6	20	51	+ 1.33	52	37	14	S.	+ 1.80
α	Canis Major	*Sirius*	1	6	38	59	+ 2.64	16	31	38	S.	+ 4.62
α	Gemini	*Castor*	3	7	25	40	+ 3.84	32	11	29	N	− 7.40
α	Canis Minor	*Procyon*	1.2	7	31	58	+ 3.15	5	34	51	N	− 8 87
β	Gemini	POLLUX	2	7	36	45	+ 3.68	28	21	38	N	− 8 23
ξ	Argo Navis		2	7	58	40	+ 2.11	39	36	35	S.	+ 9.84
γ	Argo Navis		2	8	5	13	+ 1.85	46	55	35	S.	+ 10.35
δ	Argo Navis		2	8	40	50	+ 1.66	54	11	53	S.	+ 12.88
β	Argo Navis		1	9	11	41	+ 0.73	69	8	41	S	+ 14.86
α	Hydra	*Alphard*	2	9	20	42	+ 2.95	8	3	14	S.	+ 15.37
α	Leo	REGULUS	1	10	0	55	+ 3.20	12	38	59	N	− 17.40
β	Ursa Major		2	10	53	22	+ 3.68	57	7	56	N	− 19.16
α	Ursa Major	*Dubhe*	1.2	10	55	3	+ 3.78	62	30	21	N	− 19.35
β	Leo	*Deneb*	2 3	11	42	1	+ 3.07	15	21	17	N	− 20.10
γ	Ursa Major		2	11	46	27	+ 3.20	54	28	23	N	− 20.03
α	Crux		1	12	18	50	+ 3.26	62	19	19	S.	+ 19.94
γ	Crux		2	12	23	37	+ 3.26	56	19	24	S.	+ 19.95
α	Virgo	SPICA	1	13	17	49	+ 3.15	10	25	44	S.	+ 18 96
η	Ursa Major	*Benetnach*	2.3	13	42	1	+ 2.38	50	0	47	N	− 18.12
β	Centaur		1	13	53	59	+ 4.16	59	41	48	S.	+ 17.70
α	Draco		2	14	0	36	+ 1.62	65	2	20	N	− 17 38
α	Bootes	*Arcturus*	1	14	9	17	+ 2.73	19	54	47	N	− 18.92
γ	Bootes	*Seginus*	3	14	26	27	+ 2 43	38	53	18	N	− 16.15
α	Centaur		1	14	30	10	+ 4 02	60	15	19	S.	+ 15.06
α	2 Libra	*Zubenesch*	3	14	43	8	+ 3 30	15	27	37	S.	+ 15 24
β	Libra	*Zubenelg.*	2.3	15	9	36	+ 3.22	8	51	46	S.	+ 13.60
α	Corona Borealis	*Alphacca*	2	15	28	46	+ 2 54	27	11	17	N	− 12.36
α	Serpens		2.3	15	37	22	+ 2.95	6	52	7	N	− 11.65
α	Scorpio	ANTARES	1	16	20	50	+ 3 66	26	7	3	S.	+ 8.45
α	Hercules	*Ras Algethi*	3.4	17	8	16	+ 2.73	14	33	11	N	− 4.47
α	Ophiuchus	*Ras Alhague*	2	17	28	26	+ 2.78	12	39	54	N	− 2.95
γ	Draco	*Rastaban*	2	17	53	21	+ 1 39	51	30	23	N	− 0.64
α	Lyra	*Vega*	1	18	32	16	+ 2.03	38	39	20	N	+ 3.10
α	AQUILÆ	ALTAIR	1.2	19	43	57	+ 2.93	8	30	5	N	+ 9.18
α	Pavo		2	20	14	33	+ 4 80	57	10	44	S.	− 11.09
α	Cygnus	*Deneb*	1	20	36	43	+ 2.04	44	46	50	N	+ 12.67
α	Cepheus	*Alderaimin*	3	21	15	17	+ 1.44	61	59	36	N	+ 15.10
α	Aquarius		3	21	58	42	+ 3 08	0	59	55	S.	− 17.30
α	Grux		2	21	59	31	+ 3.82	47	38	12	S.	− 17.17
α	Pisc. Australis.	FOMALHAUT	1	22	49	54	+ 3.34	30	21	46	S.	− 18.96
β	Pegasus	*Scheat*	2	22	56	58	+ 2.88	27	19	26	N	+ 19 26
* α	PEGASUS	MARCAB	2	22	57	47	+ 2.98	14	27	10	N	+ 19 30

TABLE XIV.

SUN'S MEAN RIGHT ASCENSION.

Days.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Days.
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	
1	18 46	20 58	22 48	0 42	2 33	4 35	6 40	8 45	10 41	12 29	14 25	16 29	1
2	18 50	21 02	22 52	0 45	2 37	4 40	6 44	8 49	10 44	12 32	14 29	16 33	2
3	18 54	21 06	22 56	0 49	2 40	4 44	6 48	8 52	10 48	12 36	14 33	16 37	3
4	18 59	21 10	22 59	0 53	2 44	4 48	6 52	8 56	10 52	12 40	14 37	16 42	4
5	19 03	21 14	23 03	0 56	2 48	4 52	6 56	9 00	10 55	12 43	14 41	16 46	5
6	19 08	21 18	23 07	1 00	2 52	4 56	7 00	9 04	10 59	12 47	14 45	16 51	6
7	19 12	21 22	23 10	1 04	2 56	5 00	7 04	9 08	11 02	12 51	14 49	16 55	7
8	19 16	21 26	23 14	1 07	3 00	5 04	7 09	9 12	11 06	12 54	14 53	16 59	8
9	19 21	21 30	23 18	1 11	3 04	5 08	7 13	9 15	11 10	12 58	14 57	17 04	9
10	19 25	21 34	23 21	1 15	3 08	5 13	7 17	9 19	11 13	13 02	15 01	17 08	10
11	19 29	21 38	23 25	1 18	3 11	5 17	7 21	9 23	11 17	13 05	15 05	17 13	11
12	19 34	21 42	23 29	1 22	3 15	5 21	7 25	9 27	11 20	13 09	15 09	17 17	12
13	19 38	21 46	23 33	1 26	3 19	5 25	7 29	9 31	11 24	13 13	15 13	17 21	13
14	19 42	21 50	23 36	1 29	3 23	5 29	7 33	9 34	11 28	13 16	15 17	17 26	14
15	19 47	21 54	23 40	1 33	3 27	5 33	7 37	9 38	11 31	13 20	15 21	17 30	15
16	19 51	21 58	23 43	1 37	3 31	5 37	7 41	9 42	11 35	13 24	15 25	17 35	16
17	19 55	22 02	23 47	1 40	3 35	5 42	7 45	9 46	11 38	13 28	15 30	17 39	17
18	20 00	22 05	23 51	1 44	3 39	5 46	7 49	9 49	11 42	13 31	15 34	17 43	18
19	20 04	22 09	23 54	1 48	3 43	5 50	7 53	9 53	11 46	13 35	15 38	17 48	19
20	20 08	22 13	23 58	1 51	3 47	5 54	7 57	9 57	11 49	13 39	15 42	17 52	20
21	20 12	22 17	0 02	1 55	3 51	5 58	8 01	10 00	11 53	13 43	15 46	17 57	21
22	20 17	22 21	0 05	1 59	3 55	6 02	8 05	10 04	11 56	13 46	15 50	18 01	22
23	20 21	22 25	0 09	2 03	3 59	6 07	8 09	10 08	12 00	13 50	15 55	18 06	23
24	20 25	22 28	0 13	2 06	4 03	6 11	8 13	10 12	12 04	13 54	15 59	18 10	24
25	20 29	22 32	0 16	2 10	4 07	6 15	8 17	10 15	12 07	13 58	16 03	18 15	25
26	20 33	22 36	0 20	2 14	4 11	6 19	8 21	10 19	12 11	14 02	16 07	18 19	26
27	20 37	22 40	0 23	2 18	4 15	6 23	8 25	10 23	12 14	14 06	16 12	18 23	27
28	20 42	22 43	0 27	2 21	4 19	6 27	8 29	10 26	12 18	14 09	16 16	18 28	28
29	20 46	22 46	0 31	2 25	4 23	6 31	8 33	10 30	12 22	14 13	16 20	18 32	29
30	20 50		0 34	2 29	4 27	6 36	8 37	10 33	12 25	14 17	16 25	18 37	30
31	20 54		0 38		4 31		8 41	10 37		14 21		18 41	31

TABLE XV.

For correcting the OBSERVED ALTITUDE of a FIXED STAR to find the TRUE ALTITUDE.

Obs. Alt.	Height of the Eye above the Sea, in feet.															Obs. Alt.
	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	
°	′	′	′	′	′	′	′	′	′	′	′	′	′	′	′	°
6	10.4	10.8	11.2	11.5	11.8	12.1	12.3	12.5	12.8	13.0	13.2	13.4	13.6	13.7	13.9	6
7	9.3	9.7	10.1	10.4	10.7	10.9	11.2	11.4	11.6	11.8	12.0	12.2	12.4	12.6	12.8	7
8	8.4	8.8	9.3	9.6	9.9	10.2	10.5	10.7	10.9	11.1	11.3	11.5	11.7	11.9	12.1	8
9	7.7	8.2	8.6	9.0	9.2	9.5	9.8	10.0	10.2	10.4	10.6	10.8	11.0	11.2	11.4	9
10	7.2	7.7	8.1	8.3	8.7	8.9	9.2	9.4	9.6	9.8	10.0	10.2	10.4	10.6	10.8	10
12	6.3	6.8	7.2	7.5	7.8	8.0	8.3	8.5	8.8	9.0	9.1	9.4	9.6	9.7	9.9	12
14	5.7	6.2	6.5	6.9	7.1	7.4	7.7	7.9	8.1	8.3	8.5	8.7	8.9	9.1	9.3	14
16	5.2	5.7	6.1	6.4	6.7	6.9	7.2	7.4	7.6	7.8	8.0	8.2	8.4	8.6	8.8	16
18	4.8	5.3	5.7	6.0	6.3	6.5	6.8	7.0	7.2	7.4	7.6	7.8	8.0	8.2	8.4	18
20	4.5	5.0	5.4	5.7	6.0	6.2	6.5	6.7	6.9	7.1	7.3	7.5	7.7	7.9	8.0	20
22	4.3	4.7	5.1	5.4	5.7	6.0	6.2	6.4	6.7	6.9	7.1	7.3	7.4	7.6	7.8	22
26	3.9	4.3	4.7	5.0	5.3	5.6	5.8	6.0	6.3	6.5	6.7	6.9	7.0	7.2	7.4	26
30	3.6	4.0	4.4	4.7	5.0	5.3	5.5	5.7	6.0	6.2	6.4	6.6	6.7	6.9	7.1	30
35	3.3	3.7	4.1	4.4	4.7	5.0	5.2	5.4	5.7	5.9	6.1	6.3	6.4	6.6	6.8	35
40	3.1	3.5	3.9	4.2	4.5	4.7	5.0	5.2	5.4	5.6	5.8	6.0	6.2	6.4	6.6	40
50	2.7	3.2	3.5	3.8	4.1	4.4	4.6	4.9	5.1	5.3	5.5	5.7	5.9	6.1	6.2	50
60	2.5	2.9	3.3	3.6	3.9	4.1	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	6.0	60
70	2.3	2.7	3.1	3.4	3.7	3.9	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	5.8	70
80	2.1	2.5	2.9	3.2	3.5	3.7	4.0	4.2	4.4	4.6	4.8	5.0	5.2	5.4	5.6	80
90	2.0	2.4	2.7	3.0	3.3	3.6	3.8	4.1	4.3	4.5	4.7	4.9	5.1	5.3	5.4	90

TABLE XVI.

For reducing the Time of the Moon's Passage over the Meridian of Greenwich, to the Time of its Passage over any other Meridian.

Long.	Subtract in East Long. }	Daily Var. of Moon's passing the Meridian.										{ Add in West Long		Time fr. Moon's Southing.
	40m.	42m.	44m	46m.	48m.	50m	52m	54m.	56m.	58m.	60m.	62m.	64m.	66m.	
°	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	m.	h. m.
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0 0
10	1	1	1	1	1	1	1	1	1	2	2	2	2	2	0 40
20	2	2	2	2	3	3	3	3	3	3	3	3	3	4	1 20
30	3	3	4	4	4	4	4	4	4	5	5	5	5	5	2 0
40	4	4	5	5	5	5	6	6	6	6	6	7	7	7	2 40
50	5	6	6	6	6	7	7	7	7	8	8	8	9	9	3 20
60	6	7	7	7	8	8	8	9	9	9	10	10	10	11	4 0
70	7	8	8	9	9	9	10	10	10	11	11	12	12	12	4 40
80	9	9	9	10	10	11	11	12	12	12	13	13	14	14	5 20
90	10	10	11	11	12	12	13	13	13	14	14	15	15	16	6 0
100	11	11	12	12	13	13	14	14	15	15	16	17	17	18	6 40
110	12	12	13	14	14	15	15	16	16	17	18	18	19	19	7 20
120	13	14	14	15	15	16	17	17	18	19	19	20	20	21	8 0
130	14	15	15	16	17	17	18	19	19	20	21	21	22	23	8 40
140	15	16	17	17	18	19	20	20	21	22	22	23	24	25	9 20
150	16	17	18	19	19	20	21	22	22	23	24	25	26	26	10 0
160	17	18	19	20	21	21	22	23	24	25	26	26	27	28	10 40
170	18	19	20	21	22	23	24	25	25	26	27	28	29	30	11 20
180	19	20	21	22	23	24	25	26	27	28	29	30	31	32	12 0

TABLE XVI.*

For finding the Time of High Water.

Moon's Passage over Merid.	Moon's Semidiameter.									Moon's Passage over Merid.
	14′ 30″	14′ 45″	15′ 0″	15′ 15″	15′ 30″	15 45″	16′ 0″	16′ 15″	16′ 30″	
h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
0 0	—0 4	—0 3	—0 2	—0 1	—0 0	+0 1	+0 2	+0 3	+0 5	12 0
0 20	—0 8	—0 8	—0 7	—0 6	—0 5	—0 4	—0 3	—0 2	—0 1	12 20
0 40	—0 12	—0 12	—0 11	—0 11	—0 10	—0 10	—0 9	—0 9	—0 8	12 40
1 0	—0 17	—0 17	—0 17	—0 16	—0 16	—0 16	—0 15	—0 15	—0 15	13 0
1 20	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	13 20
1 40	—0 27	—0 27	—0 27	—0 28	—0 28	—0 28	—0 29	—0 29	—0 29	13 40
2 0	—0 31	—0 31	—0 32	—0 32	—0 33	—0 33	—0 34	—0 35	—0 36	14 0
2 20	—0 36	—0 36	—0 37	—0 38	—0 39	—0 40	—0 41	—0 42	—0 43	14 20
2 40	—0 40	—0 41	—0 42	—0 43	—0 44	—0 45	—0 46	—0 47	—0 49	14 40
3 0	—0 44	—0 45	—0 47	—0 48	—0 49	—0 51	—0 52	—0 54	—0 56	15 0
3 30	—0 49	—0 51	—0 53	—0 55	—0 56	—0 58	—1 0	—1 2	—1 4	15 30
4 0	—0 55	—0 57	—0 59	—1 0	—1 2	—1 5	—1 7	—1 10	—1 12	16 0
4 30	—0 58	—1 0	—1 2	—1 3	—1 5	—1 7	—1 10	—1 13	—1 16	16 30
5 0	—1 0	—1 2	—1 4	—1 6	—1 8	—1 10	—1 13	—1 16	—1 19	17 0
5 30	—0 59	—1 1	—1 3	—1 5	—1 7	—1 9	—1 12	—1 15	—1 18	17 30
6 0	—0 55	—0 56	—0 58	—1 0	—1 2	—1 4	—1 6	—1 9	—1 12	18 0
6 20	—0 49	—0 50	—0 51	—0 52	—0 54	—0 56	—0 58	—1 0	—1 3	18 20
6 40	—0 43	—0 44	—0 45	—0 46	—0 47	—0 48	—0 49	—0 51	—0 53	18 40
6 50	—0 37	—0 37	—0 38	—0 39	—0 40	—0 41	—0 42	—0 43	—0 45	18 50
7 0	—0 32	—0 32	—0 33	—0 33	—0 34	—0 34	—0 35	—0 36	—0 37	19 0
7 10	—0 27	—0 27	—0 27	—0 27	—0 28	—0 28	—0 28	—0 29	—0 29	19 10
7 20	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	—0 22	19 20
7 30	—0 16	—0 16	—0 16	—0 15	—0 15	—0 15	—0 14	—0 14	—0 14	19 30
7 40	—0 11	—0 11	—0 10	—0 10	—0 9	—0 9	—0 8	—0 7	—0 6	19 40
7 50	—0 6	—0 6	—0 5	—0 4	—0 3	—0 2	—0 1	—0 0	+0 2	19 50
8 0	—0 1	—0 0	+0 1	+0 2	+0 3	+0 4	+0 6	+0 7	+0 9	20 0
8 20	+0 5	+0 6	+0 7	+0 9	+0 11	+0 13	+0 15	+0 17	+0 19	20 20
8 40	+0 11	+0 12	+0 14	+0 16	+0 18	+0 20	+0 22	+0 25	+0 28	20 40
9 0	+0 14	+0 16	+0 18	+0 20	+0 22	+0 24	+0 26	+0 29	+0 32	21 0
9 30	+0 16	+0 18	+0 20	+0 22	+0 24	+0 27	+0 30	+0 33	+0 36	21 30
10 0	+0 15	+0 17	+0 19	+0 21	+0 23	+0 25	+0 27	+0 30	+0 34	22 0
10 30	+0 12	+0 14	+0 15	+0 17	+0 19	+0 21	+0 23	+0 26	+0 30	22 30
11 0	+0 7	+0 8	+0 10	+0 12	+0 14	+0 16	+0 18	+0 20	+0 23	23 0
11 20	+0 4	+0 5	+0 6	+0 7	+0 9	+0 11	+0 13	+0 15	+0 17	23 20
11 40	+0 0	+0 1	+0 2	+0 3	+0 5	+0 7	+0 8	+0 10	+0 12	23 40
12 0	—0 4	—0 3	—0 2	—0 1	—0 0	+0 1	+0 2	+0 3	+0 5	24 0

TABLE XVII.

To find the LATITUDE by an Altitude of the POLAR STAR.

R. A. Merid. h. m.	Corr. for 1860. ° ′	Corr. for 1870. ° ′	R. A. Merid. h. m.	Corr. for 1860. ° ′	Corr. for 1870. ° ′	R. A. Merid. h. m.	Corr. for 1860. ° ′	Corr. for 1870. ° ′	R. A. Merid. h. m.	Corr. for 1860. ° ′	Corr. for 1870. ° ′
0 0	−1 23	−1 19	6 45	−0 9	−0 9	12 0	+1 23	+1 19	18 45	+0 9	+0 9
0 20	−1 25	−1 21	6 50	−0 7	−0 7	12 20	+1 25	+1 21	18 50	+0 7	+0 7
0 40	−1 26	−1 22	6 55	−0 5	−0 5	12 40	+1 26	+1 22	18 55	+0 5	+0 5
1 0	−1 26	−1 23	7 0	−0 3	−0 3	13 0	+1 26	+1 23	19 0	+0 3	+0 3
1 20	−1 26	−1 23	7 5	0 0	0 0	13 20	+1 26	+1 23	19 5	0 0	0 0
1 40	−1 25	−1 22	7 10	+0 1	+0 1	13 40	+1 25	+1 22	19 10	−0 1	−0 1
2 0	−1 24	−1 21	7 15	+0 3	+0 1	14 0	+1 24	+1 21	19 15	−0 3	−0 1
2 10	−1 23	−1 20	7 20	+0 5	+0 3	14 10	+1 23	+1 20	19 20	−0 5	−0 3
2 20	−1 21	−1 19	7 25	+0 7	+0 5	14 20	+1 21	+1 19	19 25	−0 7	−0 5
2 30	−1 20	−1 18	7 30	+0 9	+0 7	14 30	+1 20	+1 18	19 30	−0 9	−0 7
2 40	−1 19	−1 17	7 35	+0 11	+0 9	14 40	+1 19	+1 17	19 35	−0 11	−0 9
2 50	−1 18	−1 16	7 40	+0 13	+0 11	14 50	+1 18	+1 16	19 40	−0 13	−0 11
3 0	−1 16	−1 14	7 45	+0 15	+0 12	15 0	+1 16	+1 14	19 45	−0 15	−0 12
3 10	−1 14	−1 12	7 50	+0 17	+0 14	15 10	+1 14	+1 12	19 50	−0 17	−0 14
3 20	−1 12	−1 10	7 55	+0 18	+0 16	15 20	+1 12	+1 10	19 55	−0 18	−0 16
3 30	−1 10	−1 8	8 0	+0 19	+0 18	15 30	+1 10	+1 8	20 0	−0 19	−0 18
3 40	−1 7	−1 6	8 5	+0 21	+0 19	15 40	+1 7	+1 6	20 5	−0 21	−0 19
3 50	−1 5	−1 4	8 10	+0 23	+0 21	15 50	+1 5	+1 4	20 10	−0 23	−0 21
4 0	−1 2	−1 1	8 15	+0 25	+0 23	16 0	+1 2	+1 1	20 15	−0 25	−0 23
4 10	−1 1	−0 59	8 20	+0 27	+0 25	16 10	+1 1	+0 59	20 20	−0 27	−0 25
4 20	−0 58	−0 56	8 25	+0 28	+0 26	16 20	+0 58	+0 56	20 25	−0 28	−0 26
4 30	−0 55	−0 54	8 30	+0 29	+0 28	16 30	+0 55	+0 54	20 30	−0 29	−0 28
4 40	−0 51	−0 51	8 35	+0 31	+0 30	16 40	+0 51	+0 51	20 35	−0 31	−0 30
4 50	−0 49	−0 48	8 40	+0 34	+0 32	16 50	+0 49	+0 48	20 40	−0 34	−0 32
4 55	−0 47	−0 46	8 45	+0 36	+0 33	16 55	+0 47	+0 46	20 45	−0 36	−0 33
5 0	−0 45	−0 45	8 50	+0 38	+0 35	17 0	+0 45	+0 45	20 50	−0 38	−0 35
5 5	−0 44	−0 43	8 55	+0 39	+0 36	17 5	+0 44	+0 43	20 55	−0 39	−0 36
5 10	−0 42	−0 42	9 0	+0 42	+0 38	17 10	+0 42	+0 42	21 0	−0 42	−0 38
5 20	−0 38	−0 38	9 10	+0 45	+0 41	17 20	+0 38	+0 38	21 10	−0 45	−0 41
5 25	−0 37	−0 37	9 20	+0 48	+0 44	17 25	+0 37	+0 37	21 20	−0 48	−0 44
5 30	−0 36	−0 35	9 30	+0 51	+0 47	17 30	+0 36	+0 35	21 30	−0 51	−0 47
5 35	−0 34	−0 34	9 40	+0 53	+0 50	17 35	+0 34	+0 34	21 40	−0 53	−0 50
5 40	−0 32	−0 32	9 50	+0 56	+0 53	17 40	+0 32	+0 32	21 50	−0 56	−0 53
5 45	−0 31	−0 30	10 0	+0 59	+0 56	17 45	+0 31	+0 30	22 0	−0 59	−0 56
5 50	−0 29	−0 28	10 10	+1 2	+0 58	17 50	+0 29	+0 28	22 10	−1 2	−0 58
5 55	−0 27	−0 27	10 20	+1 4	+1 1	17 55	+0 27	+0 27	22 20	−1 4	−1 1
6 0	−0 25	−0 25	10 30	+1 7	+1 3	18 0	+0 25	+0 25	22 30	−1 7	−1 3
6 5	−0 23	−0 23	10 40	+1 9	+1 6	18 5	+0 23	+0 23	22 40	−1 9	−1 6
6 10	−0 22	−0 22	10 50	+1 10	+1 8	18 10	+0 22	+0 22	22 50	−1 10	−1 8
6 15	−0 20	−0 20	11 0	+1 12	+1 10	18 15	+0 20	+0 20	23 0	−1 12	−1 10
6 20	−0 18	−0 18	11 10	+1 15	+1 12	18 20	+0 18	+0 18	23 10	−1 15	−1 12
6 25	−0 16	−0 16	11 20	+1 17	+1 14	18 25	+0 16	+0 16	23 20	−1 17	−1 14
6 30	−0 15	−0 15	11 30	+1 19	+1 15	18 30	+0 15	+0 15	23 30	−1 19	−1 15
6 35	−0 13	−0 13	11 40	+1 20	+1 17	18 35	+0 13	+0 13	23 40	−1 20	−1 17
6 40	−0 11	−0 11	11 50	+1 22	+1 18	18 40	+0 11	+0 11	23 50	−1 22	−1 18

TABLE XVII*.

Corrections of the Latitude deduced from the above Table—*Additive.*

R. A. Merid.	APPROXIMATE LATITUDE.														R. A. Merid.
	0°	10°	20°	30°	35°	40°	45°	50°	55°	60°	65°	70°	75°	80°	
h.m.	′	′	′	′	′	′	′	′	′	′	′	′	′	′	h. m.
0 0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.6	2 0
1 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1 0
2 0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.4	0.6	24 0
4 0	0.0	0.1	0.2	0.4	0.5	0.6	0.7	0.9	1.1	1.3	1.6	2.0	2.8	4.4	22 0
5 0	0.0	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.6	1.9	2.2	2.9	3.9	6.0	21 0
6 0	0.0	0.2	0.5	0.7	0.9	1.1	1.3	1.5	1.9	2.3	2.9	3.6	4.8	7.4	20 0
7 0	0.0	0.2	0.5	0.8	1.0	1.2	1.4	1.7	2.1	2.5	3.1	3.9	5.2	8.0	19 0
8 0	0.0	0.2	0.5	0.7	0.9	1.1	1.3	1.5	1.9	2.3	2.9	3.6	4.8	7.4	18 0
9 0	0.0	0.2	0.4	0.6	0.7	0.9	1.1	1.3	1.6	1.9	2.2	2.9	3.9	6.0	17 0
11 0	0.0	0.0	0.1	0.2	0.2	0.3	0.3	0.4	0.5	0.6	0.7	0.9	1.3	1.9	15 0
13 0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13 0

TABLE XVIII.

CORRECTIONS of the APPARENT ALTITUDES of the SUN and STARS.

App. Alt.	Sun's Corr.	Star's Corr.	Diff. to 1′	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.
° ′	′ ″	′ ″	″	° ′	′ ″	′ ″	° ′	′ ″	′ ″	° ′	′ ″	′ ″
0 0	32 51	33 0	10.0	5 0	9 44	9 52	6 0	8 18	8 26	7 0	7 12	7 21
5	32 1	32 10	9.6	1	9 42	9 51	1	8 17	8 25	1	7 11	7 20
0	31 13	31 22	9.4	2	9 41	9 49	2	8 15	8 24	2	7 10	7 19
15	30 26	30 35	9.1	3	9 39	9 48	3	8 14	8 23	3	7 9	7 18
20	29 41	29 49	8.9	4	9 37	9 46	4	8 13	8 22	4	7 8	7 17
25	28 56	29 5	8.6	5	9 36	9 44	5	8 12	8 20	5	7 7	7 16
0 30	28 13	28 22	8.4	5 6	9 34	9 43	6 6	8 10	8 19	7 6	7 6	7 15
35	27 31	27 40	8.1	7	9 32	9 41	7	8 9	8 18	7	7 6	7 14
40	26 51	26 59	7.9	8	9 31	9 40	8	8 8	8 17	8	7 5	7 13
45	26 11	26 20	7.7	9	9 29	9 38	9	8 7	8 15	9	7 4	7 12
50	25 33	25 41	7.4	10	9 28	9 36	10	8 6	8 14	10	7 3	7 11
55	24 55	25 4	7.2	11	9 26	9 35	11	8 4	8 13	11	7 2	7 10
1 0	24 19	24 28	7.0	5 12	9 25	9 33	6 12	8 3	8 12	7 12	7 1	7 10
5	23 44	23 53	6.7	13	9 23	9 32	13	8 2	8 11	13	7 0	7 9
10	23 10	23 19	6.5	14	9 21	9 30	14	8 1	8 10	14	6 59	7 8
15	22 38	22 46	6.4	15	9 20	9 29	15	8 0	8 8	15	6 58	7 7
20	22 6	22 15	6.2	16	9 18	9 27	16	7 59	8 7	16	6 57	7 6
25	21 35	21 44	6.1	17	9 17	9 25	17	7 57	8 6	17	6 56	7 5
1 30	21 5	21 14	5.7	5 18	9 15	9 24	6 18	7 56	8 5	7 18	6 55	7 4
35	20 36	20 45	5.6	19	9 14	9 22	19	7 55	8 4	19	6 55	7 3
40	20 8	20 17	5.3	20	9 12	9 21	20	7 54	8 3	20	6 54	7 2
45	19 41	19 50	5.2	21	9 11	9 19	21	7 53	8 1	21	6 53	7 1
50	19 15	19 24	5.0	22	9 9	9 18	22	7 52	8 0	22	6 52	7 1
55	18 50	18 59	4.9	23	9 8	9 16	23	7 50	7 59	23	6 51	7 0
2 0	18 25	18 34	4.7	5 24	9 6	9 15	6 24	7 49	7 58	7 24	6 50	6 59
5	18 2	18 10	4.5	25	9 5	9 13	25	7 48	7 57	25	6 49	6 58
10	17 39	17 48	4.5	26	9 3	9 12	26	7 47	7 56	26	6 48	6 57
15	17 17	17 25	4.3	27	9 2	9 11	27	7 46	7 55	27	6 48	6 56
20	16 55	17 4	4.2	28	9 0	9 9	28	7 45	7 54	28	6 47	6 55
25	16 34	16 43	4.0	29	8 59	9 8	29	7 44	7 53	29	6 46	6 54
2 30	16 14	16 23	3.9	5 30	8 58	9 6	6 30	7 43	7 51	7 30	6 45	6 54
35	15 55	16 3	3.8	31	8 56	9 5	31	7 42	7 50	31	6 44	6 53
40	15 36	15 44	3.6	32	8 55	9 3	32	7 41	7 49	32	6 43	6 52
45	15 17	15 26	3.5	33	8 53	9 2	33	7 40	7 48	33	6 42	6 51
50	15 0	15 8	3.4	34	8 52	9 1	34	7 38	7 47	34	6 42	6 50
55	14 43	14 51	3.4	35	8 51	8 59	35	7 37	7 46	35	6 41	6 49
3 0	14 26	14 35	3.3	5 36	8 49	8 58	6 36	7 36	7 45	7 36	6 40	6 49
5	14 10	14 19	3.2	37	8 48	8 56	37	7 35	7 44	37	6 39	6 48
10	13 54	14 3	3.1	38	8 46	8 55	38	7 34	7 43	38	6 38	6 47
15	13 39	13 48	3.0	39	8 45	8 54	39	7 33	7 42	39	6 37	6 46
20	13 24	13 33	2.8	40	8 44	8 52	40	7 32	7 41	40	6 37	6 45
25	13 10	13 19	2.8	41	8 42	8 51	41	7 31	7 40	41	6 36	6 44
30	12 56	13 5	2.7	5 42	8 41	8 50	6 42	7 30	7 39	7 42	6 35	6 44
35	12 43	12 51	2.6	43	8 40	8 48	43	7 29	7 38	43	6 34	6 43
40	12 30	12 38	2.6	44	8 38	8 47	44	7 28	7 37	44	6 33	6 42
45	12 17	12 26	2.5	45	8 37	8 46	45	7 27	7 36	45	6 33	6 41
50	12 5	12 13	2.4	46	8 36	8 44	46	7 26	7 35	46	6 32	6 40
55	11 53	12 1	2.3	47	8 34	8 43	47	7 25	7 34	47	6 31	6 40
4 0	11 41	11 50	2.3	5 48	8 33	8 42	6 48	7 24	7 33	7 48	6 30	6 39
5	11 30	11 38	2.2	49	8 32	8 40	49	7 23	7 32	49	6 29	6 38
10	11 19	11 27	2.1	50	8 30	8 39	50	7 22	7 31	50	6 29	6 37
15	11 8	11 17	2.1	51	8 29	8 38	51	7 21	7 30	51	6 28	6 36
20	10 58	11 6	2.0	52	8 28	8 36	52	7 20	7 29	52	6 27	6 36
25	10 48	10 56	2.0	53	8 27	8 35	53	7 19	7 28	53	6 26	6 35
4 30	10 38	10 46	1.9	5 54	8 25	8 34	6 54	7 18	7 27	7 54	6 25	6 34
35	10 28	10 37	1.9	55	8 24	8 33	55	7 17	7 26	55	6 25	6 33
40	10 19	10 28	1 8	56	8 23	8 31	56	7 16	7 25	56	6 24	6 33
45	10 10	10 18	1.8	57	8 21	8 30	57	7 15	7 24	57	6 23	6 32
50	10 1	10 10	1.7	58	8 20	8 29	58	7 14	7 23	58	6 22	6 31
55	9 52	10 1	1.7	59	8 19	8 28	59	7 13	7 22	59	6 22	6 30

TABLE XVIII.

Corrections of the Apparent Altitudes of the Sun and Stars.

App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.
° '	' "	' "	° '	' "	' "	° '	' "	' "	° '	' "	' "
8 0	6 21	6 30	9 0	5 40	5 48	11 0	4 38	4 47	13 0	3 54	4 3
1	6 20	6 29	2	5 39	5 47	2	4 37	4 46	2	3 54	4 2
2	6 19	6 28	4	5 37	5 46	4	4 37	4 45	4	3 53	4 2
3	6 19	6 27	6	5 35	5 45	6	4 36	4 44	6	3 53	4 1
4	6 18	6 27	8	5 34	5 44	8	4 35	4 43	8	3 52	1
5	6 17	6 26	10	5 34	5 42	10	4 34	4 43	10	3 51	4 0
8 6	6 16	6 25	9 12	5 33	5 41	11 12	4 33	4 42	13 12	3 51	3 59
7	6 16	6 24	14	5 31	5 40	14	4 32	4 41	14	3 50	3 59
8	6 15	6 24	16	5 30	5 39	16	4 32	4 40	16	3 50	3 58
9	6 14	6 23	18	5 29	5 38	18	4 31	4 39	18	3 49	3 57
10	6 13	6 22	20	5 28	5 36	20	4 30	4 39	20	3 48	3 57
11	6 13	6 21	22	5 27	5 35	22	4 29	4 38	22	3 48	3 56
8 12	6 12	6 21	9 24	5 26	5 34	11 24	4 28	4 37	13 24	3 47	3 56
13	6 11	6 20	26	5 24	5 33	26	4 28	4 36	26	3 47	3 55
14	6 10	6 19	28	5 23	5 32	28	4 27	4 35	28	3 46	3 54
15	6 10	6 18	30	5 22	5 31	30	4 26	4 35	30	3 45	3 54
16	6 9	6 18	32	5 21	5 30	32	4 25	4 34	32	3 45	3 53
17	6 8	6 17	34	5 20	5 29	34	4 24	4 33	34	3 44	3 53
8 18	6 8	6 16	9 36	5 19	5 27	11 36	4 24	4 32	13 36	3 44	3 52
19	6 7	6 16	38	5 18	5 26	38	4 23	4 31	38	3 43	3 52
20	6 6	6 15	40	5 17	5 25	40	4 22	4 31	40	3 43	3 51
21	6 5	6 14	42	5 16	5 24	42	4 21	4 30	42	3 42	3 51
22	6 5	6 13	44	5 15	5 23	44	4 21	4 29	44	3 41	3 50
23	6 4	6 13	46	5 13	5 22	46	4 20	4 28	46	3 41	3 49
8 24	6 3	6 12	9 48	5 12	5 21	11 48	4 19	4 28	13 48	3 40	3 49
25	6 3	6 11	50	5 11	5 20	50	4 18	4 27	50	3 40	3 48
26	6 2	6 11	52	5 10	5 19	52	4 18	4 26	52	3 39	3 48
27	6 1	6 10	54	5 9	5 18	54	4 17	4 25	54	3 39	3 47
28	6 1	6 9	56	5 8	5 17	56	4 16	4 25	56	3 38	3 47
29	6 0	6 9	58	5 7	5 16	58	4 15	4 24	58	3 38	3 46
8 30	5 59	6 8	10 0	5 6	5 15	12 0	4 15	4 23	14 0	3 37	3 45
31	5 59	6 7	2	5 5	5 14	2	4 14	4 22	2	3 36	3 45
32	5 58	6 7	4	5 4	5 13	4	4 13	4 22	4	3 36	3 44
33	5 57	6 6	6	5 3	5 12	6	4 12	4 21	6	3 35	3 44
34	5 57	6 5	8	5 2	5 11	8	4 12	4 20	8	3 35	3 43
35	5 56	6 5	10	5 1	5 10	10	4 11	4 20	10	3 34	3 43
8 36	5 55	6 4	10 12	5 0	5 9	12 12	4 10	4 19	14 12	3 34	3 42
37	5 55	6 3	14	4 59	5 8	14	4 10	4 18	14	3 33	3 42
38	5 54	6 3	16	4 58	5 7	16	4 9	4 17	16	3 33	3 41
39	5 53	6 2	18	4 57	5 6	18	4 8	4 17	18	3 32	3 41
40	5 53	6 1	20	4 56	5 5	20	4 8	4 16	20	3 32	3 40
41	5 52	6 1	22	4 55	5 4	22	4 7	4 15	22	3 31	3 40
8 42	5 51	6 0	10 24	4 54	5 3	12 24	4 6	4 15	14 24	3 31	3 39
43	5 51	5 59	26	4 53	5 2	26	4 6	4 14	26	3 30	3 39
44	5 50	5 59	28	4 53	5 1	28	4 5	4 13	28	3 30	3 38
45	5 49	5 58	30	4 52	5 0	30	4 4	4 13	30	3 29	3 38
46	5 49	5 57	32	4 51	4 59	32	4 3	4 12	32	3 29	3 37
47	5 48	5 57	34	4 50	4 58	34	4 3	4 11	34	3 28	3 37
8 48	5 47	5 56	10 36	4 49	4 57	12 36	4 2	4 11	14 36	3 28	3 36
49	5 47	5 55	38	4 48	4 57	38	4 2	4 10	38	3 27	3 36
50	5 46	5 55	40	4 47	4 56	40	4 1	4 9	40	3 27	3 35
51	5 45	5 54	42	4 46	4 55	42	4 0	4 9	42	3 26	3 35
52	5 45	5 53	44	4 45	4 54	44	4 0	4 8	44	3 26	3 34
53	5 44	5 53	46	4 44	4 53	46	3 59	4 7	46	3 25	3 34
8 54	5 44	5 52	10 48	4 43	4 52	12 48	3 58	4 7	14 48	3 25	3 33
55	5 43	5 52	50	4 43	4 51	50	3 58	4 6	50	3 24	3 33
56	5 42	5 51	52	4 42	4 50	52	3 57	4 5	52	3 24	3 32
57	5 42	5 50	54	4 41	4 49	54	3 56	4 5	54	3 23	3 32
58	5 41	5 50	56	4 40	4 49	56	3 56	4 4	56	3 23	3 31
59	5 40	5 49	58	4 39	4 48	58	3 55	4 4	58	3 22	3 31

TABLE XVIII.

CORRECTIONS of the APPARENT ALTITUDES of the SUN and STARS.

App. Alt.	Sun's Corr	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.	App. Alt.	Sun's Corr.	Star's Corr.
° ′	′ ″	′ ″	° ′	′ ″	′ ″	° ′	′ ″	′ ″	° ′	′ ″	′ ″
15 0	3 22	3 30	20 0	2 27	2 35	30 0	1 31	1 38	50 0	0 42	0 48
5	3 21	3 29	10	2 26	2 34	20	1 30	1 37	30	0 41	0 47
10	3 19	3 28	20	2 25	2 33	40	1 28	1 36	51 0	0 41	0 46
15	3 18	3 27	30	2 23	2 31	31 0	1 27	1 35	30	0 40	0 45
20	3 17	3 26	40	2 22	2 30	20	1 26	1 33	52 0	0 39	0 44
25	3 16	3 24	50	2 21	2 29	40	1 25	1 32	30	0 38	0 44
15 30	3 15	3 23	21 0	2 19	2 27	32 0	1 24	1 31	53 0	0 38	0 43
35	3 14	3 22	10	2 18	2 26	20	1 22	1 30	30	0 37	0 42
40	3 13	3 21	20	2 17	2 25	40	1 21	1 29	54 0	0 36	0 41
45	3 11	3 20	30	2 16	2 24	33 0	1 20	1 27	30	0 36	0 41
50	3 10	3 19	40	2 14	2 23	20	1 19	1 26	55 0	0 35	0 40
55	3 9	3 18	50	2 13	2 21	40	1 18	1 25	30	0 34	0 39
16 0	3 8	3 17	22 0	2 12	2 20	34 0	1 17	1 24	56 0	0 34	0 38
5	3 7	3 16	10	2 11	2 19	20	1 16	1 23	30	0 33	0 38
10	3 6	3 15	20	2 10	2 18	40	1 15	1 22	57 0	0 32	0 37
15	3 5	3 14	30	2 9	2 17	35 0	1 14	1 21	30	0 32	0 36
20	3 4	3 13	40	2 8	2 16	20	1 13	1 20	58 0	0 31	0 36
25	3 3	3 12	50	2 7	2 15	40	1 12	1 19	30	0 30	0 35
16 30	3 2	3 11	23 0	2 6	2 14	36 0	1 11	1 18	59 0	0 30	0 34
35	3 1	3 10	10	2 4	2 13	20	1 10	1 17	30	0 29	0 34
40	3 0	3 9	20	2 3	2 11	40	1 9	1 16	60 0	0 29	0 33
45	2 59	3 8	30	2 2	2 10	37 0	1 9	1 15	30	0 28	0 32
50	2 58	3 7	40	2 1	2 9	20	1 8	1 15	61 0	0 27	0 32
55	2 57	3 6	50	2 0	2 8	40	1 7	1 14	30	0 27	0 31
17 0	2 56	3 5	24 0	1 59	2 7	38 0	1 6	1 13	62 0	0 26	0 30
5	2 55	3 4	10	1 58	2 6	20	1 5	1 12	30	0 26	0 30
10	2 54	3 3	20	1 57	2 5	40	1 4	1 11	63 0	0 25	0 29
15	2 54	3 2	30	1 57	2 4	39 0	1 3	1 10	30	0 24	0 28
20	2 53	3 1	40	1 56	2 4	20	1 3	1 9	64 0	0 24	0 28
25	2 52	3 0	50	1 55	2 3	40	1 2	1 9	30	0 23	0 27
17 30	2 51	2 59	25 0	1 54	2 2	40 0	1 1	1 8	65 0	0 23	0 27
35	2 50	2 58	10	1 53	2 1	20	1 0	1 7	30	0 22	0 26
40	2 49	2 57	20	1 52	2 0	40	0 59	1 6	66 0	0 22	0 25
45	2 48	2 56	30	1 51	1 59	41 0	0 59	1 5	30	0 21	0 25
50	2 47	2 56	40	1 50	1 58	20	0 58	1 5	67 0	0 21	0 24
55	2 46	2 55	50	1 49	1 57	40	0 57	1 4	30	0 20	0 24
18 0	2 46	2 54	26 0	1 49	1 56	42 0	0 57	1 3	68 0	0 20	0 23
5	2 45	2 53	10	1 48	1 56	20	0 56	1 2	69 0	0 19	0 22
10	2 44	2 52	20	1 47	1 55	40	0 55	1 2	70 0	0 18	0 21
15	2 43	2 51	30	1 46	1 54	43 0	0 55	1 1	71 0	0 17	0 20
20	2 42	2 51	40	1 45	1 53	20	0 54	1 0	72 0	0 16	0 18
25	2 41	2 50	50	1 44	1 52	40	0 53	1 0	73 0	0 15	0 17
18 30	2 41	2 49	27 0	1 44	1 51	44 0	0 53	0 59	74 0	0 14	0 16
35	2 40	2 48	10	1 43	1 51	20	0 52	0 58	75 0	0 13	0 15
40	2 39	2 47	20	1 42	1 50	40	0 51	0 58	76 0	0 12	0 14
45	2 38	2 47	30	1 41	1 49	45 0	0 51	0 57	77 0	0 11	0 13
50	2 38	2 46	40	1 41	1 48	20	0 50	0 56	78 0	0 10	0 12
55	2 37	2 45	50	1 40	1 48	40	0 49	0 56	79 0	0 9	0 11
19 0	2 36	2 44	28 0	1 39	1 47	46 0	0 49	0 55	80 0	0 8	0 10
5	2 35	2 44	10	1 38	1 46	20	0 48	0 54	81 0	0 8	0 9
10	2 35	2 43	20	1 38	1 45	40	0 48	0 54	82 0	0 7	0 8
15	2 34	2 42	30	1 37	1 45	47 0	0 47	0 53	83 0	0 6	0 7
20	2 33	2 41	40	1 36	1 44	20	0 47	0 52	84 0	0 5	0 6
25	2 32	2 41	50	1 35	1 43	40	0 46	0 52	85 0	0 4	0 5
19 30	2 32	2 40	29 0	1 35	1 42	48 0	0 45	0 51	86 0	0 3	0 4
35	2 31	2 39	10	1 34	1 42	20	0 45	0 51	87 0	0 3	0 3
40	2 30	2 38	20	1 33	1 41	40	0 44	0 50	88 0	0 2	0 2
45	2 29	2 38	30	1 33	1 40	49 0	0 44	0 49	89 0	0 1	0 1
50	2 29	2 37	40	1 32	1 40	20	0 43	0 49	90 0	0 0	0 0
55	2 28	2 36	50	1 31	1 39	40	0 43	0 48			

TABLE XIX.

FOR REDUCING LONGITUDE INTO TIME, AND THE CONTRARY.

°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.	°	h. m.
′	m. s.	′	m. s.	′	m. s.	′	m. s.	′	m. s.	′	m. s.
″	s. t.	″	s. t.	″	s. t.	″	s. t.	″	s. t.	″	s. t.
1	0 4	31	2 4	61	4 4	91	6 4	121	8 4	151	10 4
2	0 8	32	2 8	62	4 8	92	6 8	122	8 8	152	10 8
3	0 12	33	2 12	63	4 12	93	6 12	123	8 12	153	10 12
4	0 16	34	2 16	64	4 16	94	6 16	124	8 16	154	10 16
5	0 20	35	2 20	65	4 20	95	6 20	125	8 20	155	10 20
6	0 24	36	2 24	66	4 24	96	6 24	126	8 24	156	10 24
7	0 28	37	2 28	67	4 28	97	6 28	127	8 28	157	10 28
8	0 32	38	2 32	68	4 32	98	6 32	128	8 32	158	10 32
9	0 36	39	2 36	69	4 36	99	6 36	129	8 36	159	10 36
10	0 40	40	2 40	70	4 40	100	6 40	130	8 40	160	10 40
11	0 44	41	2 44	71	4 44	101	6 44	131	8 44	161	10 44
12	0 48	42	2 48	72	4 48	102	6 48	132	8 48	162	10 48
13	0 52	43	2 52	73	4 52	103	6 52	133	8 52	163	10 52
14	0 56	44	2 56	74	4 56	104	6 56	134	8 56	164	10 56
15	1 0	45	3 0	75	5 0	105	7 0	135	9 0	165	11 0
16	1 4	46	3 4	76	5 4	106	7 4	136	9 4	166	11 4
17	1 8	47	3 8	77	5 8	107	7 8	137	9 8	167	11 8
18	1 12	48	3 12	78	5 12	108	7 12	138	9 12	168	11 12
19	1 16	49	3 16	79	5 16	109	7 16	139	9 16	169	11 16
20	1 20	50	3 20	80	5 20	110	7 20	140	9 20	170	11 20
21	1 24	51	3 24	81	5 24	111	7 24	141	9 24	171	11 24
22	1 28	52	3 28	82	5 28	112	7 28	142	9 28	172	11 28
23	1 32	53	3 32	83	5 32	113	7 32	143	9 32	173	11 32
24	1 36	54	3 36	84	5 36	114	7 36	144	9 36	174	11 36
25	1 40	55	3 40	85	5 40	115	7 40	145	9 40	175	11 40
26	1 44	56	3 44	86	5 44	116	7 44	146	9 44	176	11 44
27	1 48	57	3 48	87	5 48	117	7 48	147	9 48	177	11 48
28	1 52	58	3 52	88	5 52	118	7 52	148	9 52	178	11 52
29	1 56	59	3 56	89	5 56	119	7 56	149	9 56	179	11 56
30	2 0	60	4 0	90	6 0	120	8 0	150	10 0	180	12 0

TABLE XX.

FOR FINDING THE DISTANCE OF TERRESTRIAL OBJECTS AT SEA.

Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.	Height in feet.	Dist. in miles.
1	1.15	25	5.74	49	8.0	180	15 4	420	23.5	820	32.9	2500	57.4
2	1.62	26	5.86	50	8.1	190	15.8	430	23.8	840	33.3	2600	58.6
3	1.99	27	5.97	55	8.5	200	16.2	440	24.1	860	33.7	2700	59.7
4	2.30	28	6.08	60	8.9	210	16.6	450	24.4	880	34.1	2800	60.8
5	2.57	29	6.18	65	9.3	220	17.0	460	24.6	900	34.5	2900	61.8
6	2.81	30	6.30	70	9.6	230	17.4	470	24.9	920	34.8	3000	63.0
7	3.04	31	6.40	75	9.9	240	17.8	480	25.2	940	35.2	3100	64.0
8	3.25	32	6.50	80	10.3	250	18.2	490	25.4	960	35.6	3200	65.0
9	3.45	33	6.60	85	10.6	260	18.5	500	25.7	980	36.0	3300	66.0
10	3.63	34	6.70	90	10.9	270	18.9	520	26.2	1000	36.3	3400	67.0
11	3.81	35	6.80	95	11.2	280	19.2	540	26.7	1100	38.1	3500	68.0
12	3.98	36	6.90	100	11.5	290	19.6	560	27.2	1200	39.8	3600	69.0
13	4.14	37	6.99	105	11.8	300	19.9	580	27.7	1300	41.4	3700	69.9
14	4.30	38	7.09	110	12.1	310	20.2	600	28.1	1400	43.0	3800	70.9
15	4.45	39	7.17	115	12.3	320	20.6	620	28.6	1500	44.5	3900	71.7
16	4.60	40	7.27	120	12.6	330	20.9	640	29.1	1600	46.0	4000	72.7
17	4.73	41	7.36	125	12.8	340	21.2	660	29.5	1700	47.3	4100	73.6
18	4.87	42	7.44	130	13.1	350	21.5	680	30.0	1800	48.7	4200	74.4
19	5.01	43	7.54	135	13.3	360	21.8	700	30.4	1900	50.1	4300	75.4
20	5.14	44	7.62	140	13.6	370	22.1	720	30.8	2000	51.4	4400	76.2
21	5.26	45	7.70	145	13.8	380	22.4	740	31.2	2100	52.6	4500	77.0
22	5.39	46	7.79	150	14.1	390	22.7	760	31.7	2200	53.9	4700	78.8
23	5.51	47	7.88	160	14.5	400	23.0	780	32.1	2300	55.1	5000	81.2
24	5.62	48	7.96	170	15.0	410	23.3	800	32.5	2400	56.2	1 mile	83 5

TABLE XXI.

For reducing the SUN'S DECLINATION to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

When Sun's dec. is increasing.	add in W. lon. sub. in E. lon.	Add for Greenw. time.	When Sun's dec. is decreasing.	sub. in W. lon. add in E. lon.	Sub. for Greenw. time.

Long.	SUN'S DECLINATION.												Time fr. Noon.
	0°	2°	4°	6°	8°	9°	10°	11°	12°	13°	14°	15°	
0°	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0h. 0m.
3	0 12	0 12	0 12	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 9	0 9	0 12
6	0 24	0 24	0 24	0 23	0 23	0 22	0 22	0 21	0 20	0 20	0 18	0 18	0 24
9	0 35	0 35	0 35	0 34	0 34	0 33	0 32	0 32	0 31	0 30	0 28	0 27	0 36
12	0 47	0 47	0 47	0 46	0 45	0 44	0 43	0 42	0 41	0 40	0 38	0 37	0 48
15	0 59	0 59	0 58	0 57	0 56	0 55	0 54	0 53	0 51	0 50	0 48	0 46	1 0
18	1 11	1 10	1 10	1 9	1 7	1 6	1 5	1 3	1 1	1 0	0 58	0 55	1 12
21	1 22	1 22	1 22	1 21	1 18	1 17	1 16	1 14	1 12	1 9	1 7	1 5	1 24
24	1 34	1 34	1 33	1 32	1 29	1 28	1 27	1 24	1 22	1 19	1 17	1 14	1 36
27	1 46	1 45	1 44	1 43	1 41	1 39	1 38	1 35	1 32	1 29	1 27	1 23	1 48
30	1 58	1 57	1 56	1 54	1 51	1 49	1 48	1 45	1 43	1 39	1 36	1 32	2 0
33	2 10	2 10	2 8	2 6	2 3	2 1	1 59	1 55	1 53	1 49	1 46	1 42	2 12
36	2 22	2 21	2 19	2 17	2 14	2 12	2 10	2 6	2 3	1 59	1 56	1 51	2 24
39	2 33	2 32	2 31	2 29	2 25	2 23	2 20	2 16	2 14	2 9	2 5	2 1	2 36
42	2 45	2 44	2 43	2 40	2 36	2 34	2 31	2 27	2 24	2 19	2 15	2 10	2 48
45	2 57	2 56	2 54	2 51	2 47	2 44	2 41	2 38	2 34	2 29	2 24	2 19	3 0
48	3 9	3 8	3 6	3 3	2 59	2 55	2 52	2 49	2 44	2 39	2 34	2 28	3 12
51	3 20	3 19	3 18	3 15	3 10	3 6	3 3	3 0	2 55	2 49	2 44	2 38	3 24
54	3 32	3 31	3 30	3 26	3 21	3 17	3 14	3 10	3 5	2 59	2 53	2 47	3 36
57	3 43	3 42	3 41	3 37	3 32	3 28	3 25	3 21	3 15	3 9	3 3	2 56	3 48
60	3 55	3 54	3 52	3 48	3 43	3 39	3 35	3 31	3 25	3 19	3 3	3 5	4 0
63	4 7	4 6	4 4	4 0	3 54	3 50	3 46	3 42	3 35	3 29	3 22	3 14	4 12
66	4 19	4 18	4 16	4 12	4 5	4 1	3 57	3 52	3 46	3 39	3 32	3 23	4 24
69	4 31	4 30	4 27	4 23	4 16	4 12	4 8	4 3	3 56	3 49	3 42	3 32	4 36
72	4 43	4 42	4 39	4 34	4 27	4 23	4 19	4 13	4 6	3 59	3 51	3 41	4 48
75	4 54	4 53	4 50	4 45	4 38	4 34	4 29	4 23	4 16	4 9	4 1	3 51	5 0
78	5 6	5 5	5 2	4 57	4 50	4 45	4 40	4 34	4 27	4 19	4 11	4 0	5 12
81	5 18	5 17	5 14	5 9	5 1	4 56	4 51	4 44	4 37	4 29	4 20	4 9	5 24
84	5 30	5 28	5 26	5 20	5 12	5 7	5 2	4 55	4 47	4 39	4 30	4 18	5 36
87	5 41	5 40	5 37	5 31	5 23	5 18	5 13	5 5	4 58	4 49	4 40	4 27	5 48
90	5 53	5 52	5 48	5 42	5 34	5 29	5 23	5 16	5 8	4 59	4 49	4 37	6 0
93	6 5	6 4	6 0	5 54	5 46	5 41	5 34	5 27	5 18	5 9	4 59	4 46	6 12
96	6 17	6 15	6 12	6 6	5 57	5 52	5 45	5 37	5 28	5 19	5 9	4 55	6 24
99	6 28	6 27	6 23	6 17	6 8	6 3	5 56	5 48	5 39	5 29	5 18	5 5	6 36
102	6 40	6 39	6 35	6 28	6 19	6 14	6 7	5 58	5 49	5 39	5 28	5 14	6 48
105	6 52	6 51	6 46	6 39	6 30	6 24	6 17	6 9	5 59	5 49	5 37	5 23	7 0
108	7 4	7 2	6 58	6 51	6 41	6 35	6 28	6 19	6 9	5 59	5 47	5 32	7 12
111	7 15	7 14	7 10	7 3	6 52	6 46	6 39	6 30	6 20	6 9	5 56	5 42	7 24
114	7 27	7 26	7 22	7 15	7 3	6 57	6 50	6 40	6 30	6 19	6 6	5 51	7 36
117	7 39	7 37	7 33	7 26	7 14	7 8	7 1	6 51	6 40	6 29	6 15	6 1	7 48
120	7 51	7 49	7 44	7 37	7 25	7 18	7 11	7 1	6 51	6 39	6 25	6 10	8 0
123	8 3	8 1	7 56	7 49	7 37	7 29	7 22	7 12	7 1	6 49	6 35	6 19	8 12
126	8 14	8 13	8 8	8 0	7 48	7 40	7 33	7 22	7 11	6 59	6 44	6 28	8 24
129	8 26	8 24	8 20	8 11	7 59	7 51	7 43	7 33	7 22	7 9	6 54	6 37	8 36
132	8 38	8 36	8 31	8 22	8 10	8 2	7 54	7 43	7 32	7 18	7 4	6 46	8 48
135	8 50	8 48	8 42	8 33	8 21	8 13	8 4	7 54	7 42	7 28	7 13	6 56	9 0
138	9 1	8 59	8 54	8 45	8 33	8 24	8 15	8 5	7 52	7 38	7 23	7 5	9 12
141	9 13	9 11	9 6	8 57	8 44	8 35	8 26	8 15	8 3	7 48	7 33	7 14	9 24
144	9 25	9 23	9 18	9 8	8 55	8 46	8 37	8 26	8 13	7 58	7 42	7 23	9 36
147	9 37	9 35	9 29	9 19	9 6	8 57	8 48	8 36	8 23	8 8	7 52	7 32	9 48
150	9 48	9 45	9 40	9 30	9 17	9 8	8 58	8 47	8 33	8 18	8 2	7 42	10 0
153	10 0	9 57	9 52	9 42	9 28	9 19	9 9	8 57	8 43	8 28	8 12	7 51	10 12
156	10 12	10 9	10 4	9 54	9 39	9 30	9 20	9 8	8 54	8 38	8 21	8 0	10 24
159	10 24	10 21	10 16	10 5	9 50	9 41	9 31	9 18	9 4	8 48	8 31	8 10	10 36
162	10 36	10 33	10 27	10 16	10 1	9 52	9 42	9 29	9 14	8 58	8 41	8 19	10 48
165	10 47	10 44	10 38	10 27	10 12	10 3	9 52	9 39	9 24	9 8	8 50	8 28	11 0
168	10 59	10 56	10 50	10 39	10 24	10 14	10 3	9 50	9 35	9 18	9 0	8 38	11 12
171	11 11	11 8	11 2	10 51	10 35	10 25	10 14	10 0	9 45	9 28	9 10	8 47	11 24
174	11 23	11 20	11 14	11 3	10 46	10 36	10 25	10 11	9 55	9 38	9 19	8 57	11 36
177	11 34	11 31	11 25	11 14	10 57	10 47	10 36	10 21	10 6	9 48	9 29	9 6	11 48
180	11 46	11 43	11 37	11 25	11 8	10 58	10 46	10 32	10 16	9 58	9 38	9 15	12 0

TABLE XXI.

For reducing the SUN'S DECLINATION to Noon at any given Meridian, and to any Time at the Meridian of Greenwich.

When Sun's dec. is increasing.	add in W. lon. sub. in E. lon.	Add for Greenw. time.	When Sun's dec. is decreasing.	sub. in W. lon. add. in E. lon.	Sub. for Greenw. time.

Long.	SUN'S DECLINATION.														Time fr. Noon.
	16°	17°	18°	19°	19°30′	20°	20°30′	21°	21°30′	22°	22°30′	23°	23°15′	23°28′	
0°	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0′ 0″	0h 0m
3	0 9	0 8	0 8	0 7	0 7	0 6	0 6	0 5	0 5	0 4	0 3	0 2	0 2	0 0	0 12
6	0 18	0 16	0 16	0 14	0 13	0 12	0 11	0 10	0 9	0 8	0 6	0 4	0 4	0 0	0 24
9	0 27	0 24	0 24	0 21	0 20	0 18	0 17	0 15	0 14	0 12	0 10	0 7	0 5	0 0	0 36
12	0 36	0 32	0 31	0 28	0 27	0 25	0 23	0 21	0 19	0 16	0 14	0 9	0 7	0 0	0 48
15	0 44	0 41	0 39	0 35	0 34	0 32	0 29	0 27	0 24	0 21	0 18	0 12	0 9	0 0	1 0
18	0 53	0 49	0 46	0 42	0 40	0 38	0 35	0 32	0 29	0 25	0 21	0 14	0 10	0 0	1 2
21	1 2	0 57	0 54	0 49	0 47	0 44	0 41	0 38	0 34	0 29	0 24	0 17	0 12	0 0	1 24
24	1 11	1 5	1 2	0 56	0 54	0 50	0 47	0 44	0 39	0 34	0 28	0 19	0 14	0 0	1 36
27	1 20	1 14	1 10	1 3	1 1	0 57	0 53	0 50	0 44	0 39	0 32	0 22	0 15	0 0	1 48
30	1 28	1 23	1 18	1 11	1 8	1 4	0 59	0 55	0 49	0 43	0 36	0 25	0 17	0 0	2 0
33	1 37	1 31	1 25	1 18	1 14	1 10	1 4	1 0	0 53	0 47	0 39	0 27	0 19	0 0	2 12
36	1 46	1 39	1 33	1 25	1 21	1 16	1 10	1 5	0 58	0 51	0 42	0 30	0 20	0 0	2 24
39	1 55	1 47	1 41	1 32	1 28	1 22	1 16	1 10	1 3	0 55	0 46	0 32	0 22	0 0	2 36
42	2 4	1 56	1 49	1 39	1 35	1 29	1 22	1 16	1 8	0 59	0 50	0 34	0 24	0 0	2 48
45	2 12	2 5	1 57	1 46	1 42	1 36	1 28	1 22	1 13	1 4	0 54	0 36	0 25	0 0	3 0
48	2 21	2 13	2 4	1 53	1 48	1 42	1 33	1 27	1 18	1 8	0 57	0 39	0 27	0 0	3 12
51	2 30	2 21	2 12	2 0	1 55	1 48	1 39	1 32	1 23	1 12	1 0	0 42	0 29	0 0	3 24
54	2 39	2 29	2 20	2 7	2 2	1 54	1 45	1 38	1 28	1 16	1 3	0 44	0 30	0 0	3 36
57	2 48	2 38	2 28	2 15	2 9	2 1	1 52	1 44	1 33	1 21	1 7	0 47	0 32	0 0	3 48
60	2 56	2 47	2 36	2 23	2 16	2 8	1 59	1 49	1 39	1 26	1 11	0 49	0 34	0 0	4 0
63	3 5	2 55	2 43	2 29	2 22	2 14	2 4	1 54	1 43	1 30	1 14	0 51	0 35	0 0	4 12
66	3 14	3 3	2 51	2 36	2 29	2 20	2 10	1 59	1 48	1 34	1 17	0 54	0 37	0 0	4 24
69	3 23	3 11	2 59	2 43	2 36	2 26	2 16	2 4	1 53	1 38	1 21	0 56	0 39	0 0	4 36
72	3 32	3 19	3 7	2 50	2 43	2 33	2 21	2 10	1 58	1 42	1 25	0 59	0 40	0 0	4 48
75	3 40	3 28	3 15	2 58	2 50	2 40	2 27	2 16	2 3	1 47	1 29	1 1	0 42	0 0	5 0
78	3 49	3 36	3 22	3 5	2 56	2 46	2 33	2 21	2 8	1 51	1 32	1 4	0 44	0 0	5 12
81	3 58	3 44	3 30	3 12	3 3	2 52	2 39	2 26	2 13	1 55	1 35	1 6	0 45	0 0	5 24
84	4 7	3 52	3 38	3 19	3 10	2 58	2 45	2 32	2 18	1 59	1 39	1 9	0 47	0 0	5 36
87	4 16	4 1	3 46	3 26	3 17	3 5	2 52	2 38	2 23	2 4	1 43	1 11	0 49	0 0	5 48
90	4 25	4 10	3 54	3 34	3 24	3 12	2 59	2 44	2 28	2 9	1 47	1 14	0 50	0 0	6 0
93	4 34	4 18	4 1	3 41	3 30	3 18	3 4	2 49	2 32	2 13	1 50	1 16	0 52	0 0	6 12
96	4 43	4 26	4 9	3 48	3 37	3 24	3 9	2 54	2 37	2 17	1 53	1 19	0 54	0 0	6 24
99	4 52	4 34	4 17	3 55	3 44	3 30	3 15	2 59	2 42	2 21	1 57	1 21	0 55	0 0	6 36
102	5 0	4 43	4 25	4 2	3 51	3 37	3 21	3 5	2 47	2 25	2 1	1 24	0 57	0 0	6 48
105	5 8	4 52	4 33	4 9	3 58	3 44	3 27	3 11	2 52	2 30	2 5	1 26	0 59	0 0	7 0
108	5 17	5 0	4 40	4 16	4 4	3 50	3 33	3 16	2 57	2 34	2 9	1 29	1 0	0 0	7 12
111	5 26	5 8	4 48	4 23	4 11	3 56	3 39	3 21	3 2	2 38	2 12	1 31	1 2	0 0	7 24
114	5 35	5 16	4 56	4 30	4 18	4 2	3 46	3 27	3 7	2 43	2 16	1 34	1 4	0 0	7 36
117	5 44	5 25	5 4	4 38	4 25	4 9	3 52	3 33	3 12	2 48	2 20	1 37	1 5	0 0	7 48
120	5 53	5 34	5 12	4 46	4 32	4 16	3 59	3 39	3 17	2 53	2 23	1 39	1 7	0 0	8 0
123	6 2	5 42	5 19	4 53	4 38	4 22	4 4	3 44	3 22	2 57	2 26	1 41	1 9	0 0	8 12
126	6 11	5 50	5 27	5 0	4 45	4 28	4 10	3 49	3 27	3 1	2 29	1 44	1 10	0 0	8 24
129	6 19	5 58	5 35	5 7	4 52	4 34	4 16	3 54	3 32	3 5	2 33	1 46	1 12	0 0	8 36
132	6 28	6 6	5 43	5 14	4 59	4 41	4 22	3 59	3 37	3 9	2 36	1 49	1 14	0 0	8 48
135	6 36	6 15	5 51	5 21	5 6	4 48	4 28	4 5	3 42	3 13	2 40	1 51	1 15	0 0	9 0
138	6 45	6 23	5 58	5 28	5 12	4 54	4 34	4 10	3 47	3 17	2 43	1 54	1 17	0 0	9 12
141	6 54	6 31	6 6	5 35	5 19	5 0	4 40	4 15	3 52	3 21	2 46	1 56	1 19	0 0	9 24
144	7 3	6 39	6 14	5 42	5 26	5 6	4 46	4 21	3 57	3 26	2 50	1 59	1 20	0 0	9 36
147	7 12	6 48	6 22	5 49	5 33	5 13	4 52	4 27	4 2	3 30	2 54	2 1	1 22	0 0	9 48
150	7 21	6 57	6 30	5 57	5 40	5 20	4 58	4 33	4 7	3 35	2 58	2 4	1 24	0 0	10 0
153	7 30	7 5	6 37	6 4	5 46	5 26	5 3	4 38	4 11	3 39	3 1	2 6	1 25	0 0	10 12
156	7 39	7 13	6 45	6 11	5 53	5 32	5 9	4 43	4 16	3 43	3 4	2 9	1 27	0 0	10 24
159	7 48	7 21	6 53	6 18	6 0	5 38	5 15	4 48	4 21	3 47	3 8	2 11	1 29	0 0	10 36
162	7 57	7 29	7 1	6 25	6 7	5 45	5 21	4 54	4 26	3 51	3 12	2 13	1 30	0 0	10 48
165	8 5	7 38	7 9	6 32	6 14	5 52	5 26	5 0	4 31	3 56	3 16	2 15	1 32	0 0	11 0
168	8 14	7 46	7 16	6 39	6 20	5 58	5 32	5 6	4 36	4 0	3 19	2 17	1 34	0 0	11 12
171	8 23	7 54	7 24	6 46	6 27	6 4	5 38	5 11	4 41	4 4	3 22	2 20	1 35	0 0	11 24
174	8 32	8 3	7 32	6 53	6 34	6 10	5 44	5 17	4 46	4 9	3 26	2 22	1 37	0 0	11 6
177	8 41	8 12	7 40	7 1	6 41	6 17	5 51	5 23	4 51	4 14	3 30	2 25	1 39	0 0	11 48
180	8 49	8 21	7 48	7 9	6 48	6 24	5 58	5 29	4 56	4 19	3 34	2 28	1 40	0 0	12 0

TABLE XXII.

For reducing the SUN'S RIGHT ASCENSION to any Time at the Meridian of Greenwich.

Time fr. Noon.	SUN'S RIGHT ASCENSION.												Time fr. Noon.
	0 h.	1 h.	2 h.	3 h.	4 h.	5 h.	6 h.	7 h.	8 h.	9 h.	10 h.	11 h.	
h. m.	m. s.	m. s.	m s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	h. m.
0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
0 12	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 12
0 24	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 4	0 24
0 36	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 6	0 5	0 36
0 48	0 7	0 7	0 7	0 8	0 8	0 8	0 8	0 8	0 8	0 8	0 7	0 7	0 48
1 0	0 9	0 9	0 9	0 10	0 10	0 10	0 10	0 10	0 10	0 10	0 9	0 9	1 0
1 12	0 11	0 11	0 11	0 12	0 12	0 12	0 12	0 12	0 12	0 11	0 11	0 11	1 12
1 24	0 13	0 13	0 13	0 14	0 14	0 14	0 14	0 14	0 14	0 13	0 13	0 13	1 24
1 36	0 15	0 15	0 15	0 15	0 16	0 16	0 17	0 16	0 16	0 15	0 15	0 14	1 36
1 48	0 16	0 16	0 17	0 17	0 18	0 18	0 19	0 18	0 18	0 17	0 17	0 16	1 48
2 0	0 18	0 18	0 19	0 19	0 20	0 21	0 21	0 21	0 20	0 19	0 18	0 18	2 0
2 12	0 20	0 20	0 21	0 21	0 22	0 23	0 23	0 23	0 22	0 21	0 20	0 20	2 12
2 24	0 22	0 22	0 22	0 23	0 24	0 25	0 25	0 25	0 24	0 23	0 22	0 22	2 24
2 36	0 24	0 24	0 24	0 25	0 26	0 27	0 27	0 27	0 26	0 25	0 24	0 23	2 36
2 48	0 25	0 25	0 26	0 27	0 28	0 29	0 29	0 29	0 28	0 27	0 26	0 25	2 48
3 0	0 27	0 27	0 28	0 29	0 30	0 31	0 31	0 31	0 30	0 29	0 28	0 27	3 0
3 12	0 29	0 29	0 30	0 31	0 32	0 33	0 33	0 33	0 32	0 31	0 30	0 29	3 12
3 24	0 31	0 31	0 32	0 33	0 34	0 35	0 35	0 35	0 34	0 33	0 32	0 31	3 24
3 36	0 33	0 33	0 34	0 35	0 36	0 37	0 37	0 37	0 36	0 35	0 33	0 32	3 36
3 48	0 35	0 35	0 36	0 37	0 38	0 39	0 39	0 39	0 38	0 36	0 35	0 34	3 48
4 0	0 36	0 36	0 37	0 39	0 40	0 41	0 42	0 41	0 40	0 38	0 37	0 36	4 0
4 12	0 38	0 38	0 39	0 41	0 42	0 43	0 44	0 43	0 42	0 40	0 39	0 38	4 12
4 24	0 40	0 40	0 41	0 43	0 44	0 45	0 46	0 45	0 44	0 42	0 41	0 40	4 24
4 36	0 42	0 42	0 43	0 45	0 46	0 47	0 48	0 47	0 46	0 44	0 42	0 41	4 36
4 48	0 44	0 44	0 45	0 46	0 48	0 49	0 50	0 49	0 48	0 46	0 44	0 43	4 48
5 0	0 45	0 46	0 47	0 48	0 50	0 51	0 52	0 51	0 50	0 48	0 46	0 45	5 0
5 12	0 47	0 47	0 49	0 50	0 52	0 54	0 54	0 53	0 52	0 50	0 48	0 47	5 12
5 24	0 49	0 49	0 50	0 52	0 54	0 56	0 56	0 55	0 54	0 52	0 50	0 49	5 24
5 36	0 51	0 51	0 52	0 54	0 56	0 58	0 58	0 58	0 56	0 54	0 52	0 50	5 36
5 48	0 53	0 53	0 54	0 56	0 58	1 0	1 0	1 0	0 58	0 56	0 54	0 52	5 48
6 0	0 54	0 55	0 56	0 58	1 0	1 2	1 2	1 2	1 0	0 58	0 55	0 54	6 0
6 12	0 56	0 56	0 58	1 0	1 2	1 4	1 4	1 4	1 2	1 0	0 57	0 56	6 12
6 24	0 58	0 58	1 0	1 2	1 4	1 6	1 6	1 6	1 4	1 2	0 59	0 58	6 24
6 36	1 0	1 0	1 2	1 4	1 6	1 8	1 9	1 8	1 6	1 3	1 1	0 59	6 36
6 48	1 2	1 2	1 3	1 6	1 8	1 10	1 11	1 10	1 8	1 5	1 3	1 1	6 48
7 0	1 4	1 4	1 5	1 8	1 10	1 12	1 13	1 12	1 10	1 7	1 5	1 3	7 0
7 12	1 5	1 6	1 7	1 10	1 12	1 14	1 15	1 14	1 12	1 9	1 7	1 5	7 12
7 24	1 7	1 7	1 9	1 12	1 14	1 16	1 17	1 16	1 14	1 11	1 8	1 7	7 24
7 36	1 9	1 9	1 11	1 14	1 16	1 18	1 19	1 18	1 16	1 13	1 10	1 9	7 36
7 48	1 11	1 11	1 13	1 16	1 18	1 20	1 21	1 20	1 18	1 15	1 12	1 10	7 48
8 0	1 13	1 13	1 15	1 17	1 20	1 22	1 23	1 22	1 20	1 17	1 14	1 12	8 0
8 12	1 14	1 15	1 17	1 19	1 22	1 25	1 25	1 24	1 22	1 19	1 16	1 14	8 12
8 24	1 16	1 16	1 18	1 21	1 24	1 27	1 27	1 26	1 24	1 21	1 18	1 16	8 24
8 36	1 18	1 18	1 20	1 23	1 26	1 29	1 29	1 28	1 26	1 23	1 19	1 18	8 36
8 48	1 20	1 20	1 22	1 25	1 28	1 31	1 31	1 30	1 28	1 25	1 21	1 19	8 48
9 0	1 22	1 22	1 24	1 27	1 30	1 33	1 34	1 32	1 30	1 26	1 23	1 21	9 0
9 12	1 24	1 24	1 26	1 29	1 32	1 35	1 36	1 35	1 32	1 28	1 25	1 23	9 12
9 24	1 26	1 26	1 28	1 31	1 34	1 37	1 38	1 37	1 34	1 30	1 27	1 25	9 24
9 36	1 27	1 27	1 30	1 33	1 36	1 39	1 40	1 39	1 36	1 32	1 29	1 27	9 36
9 48	1 29	1 29	1 32	1 35	1 38	1 41	1 42	1 41	1 38	1 34	1 31	1 28	9 48
10 0	1 31	1 31	1 33	1 37	1 40	1 43	1 44	1 43	1 40	1 36	1 32	1 30	10 0
10 12	1 33	1 33	1 35	1 39	1 42	1 45	1 46	1 45	1 42	1 38	1 34	1 32	10 12
10 24	1 34	1 35	1 37	1 41	1 44	1 47	1 48	1 47	1 44	1 40	1 36	1 34	10 24
10 36	1 36	1 37	1 39	1 43	1 46	1 49	1 50	1 49	1 46	1 42	1 38	1 36	10 36
10 48	1 38	1 38	1 41	1 45	1 48	1 51	1 52	1 51	1 48	1 44	1 40	1 37	10 48
11 0	1 40	1 40	1 43	1 46	1 50	1 53	1 54	1 53	1 50	1 46	1 42	1 39	11 0
11 12	1 42	1 42	1 45	1 48	1 52	1 55	1 56	1 55	1 52	1 48	1 44	1 41	11 12
11 24	1 44	1 44	1 46	1 50	1 54	1 57	1 59	1 57	1 54	1 49	1 45	1 43	11 24
11 36	1 45	1 46	1 48	1 52	1 57	2 0	2 1	1 59	1 56	1 51	1 47	1 45	11 36
11 48	1 47	1 48	1 50	1 54	1 59	2 2	2 3	2 1	1 58	1 53	1 49	1 46	11 48
12 0	1 49	1 49	1 52	1 56	2 1	2 4	2 5	2 3	2 0	1 55	1 51	1 48	12 0

TABLE XXII.

For reducing the SUN'S RIGHT ASCENSION to any Time at the Meridian of Greenwich.

Timefr. Noon.	SUN'S RIGHT ASCENSION.												Timefr. Noon.
	12h.	13h.	14h.	15h.	16h.	17h.	18h.	19h.	20h.	21h.	22h.	23h.	
h. m.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	m. s.	h. m.
0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
0 12	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 2	0 12
0 24	0 4	0 4	0 4	0 4	0 4	0 4	0 5	0 4	0 4	0 4	0 4	0 4	0 24
0 36	0 5	0 5	0 6	0 6	0 6	0 7	0 7	0 7	0 6	0 6	0 6	0 6	0 36
0 48	0 7	0 7	0 8	0 8	0 8	0 9	0 9	0 9	0 8	0 8	0 8	0 7	0 48
1 0	0 9	0 9	0 10	0 10	0 11	0 11	0 11	0 11	0 11	0 10	0 10	0 9	1 0
1 12	0 11	0 11	0 11	0 12	0 13	0 13	0 13	0 13	0 13	0 12	0 12	0 11	1 12
1 24	0 13	0 13	0 13	0 14	0 15	0 15	0 16	0 15	0 15	0 14	0 14	0 13	1 24
1 36	0 14	0 15	0 15	0 16	0 17	0 17	0 18	0 18	0 17	0 16	0 15	0 15	1 36
1 48	0 16	0 17	0 17	0 18	0 19	0 20	0 20	0 20	0 19	0 18	0 17	0 17	1 48
2 0	0 18	0 18	0 19	0 20	0 21	0 22	0 22	0 22	0 21	0 20	0 19	0 19	2 0
2 12	0 20	0 20	0 21	0 22	0 23	0 24	0 24	0 24	0 23	0 22	0 21	0 21	2 12
2 24	0 22	0 22	0 23	0 24	0 25	0 26	0 27	0 26	0 25	0 24	0 23	0 23	2 24
2 36	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 29	0 28	0 26	0 25	0 24	2 36
2 48	0 25	0 26	0 27	0 28	0 30	0 31	0 31	0 31	0 30	0 28	0 27	0 26	2 48
3 0	0 27	0 28	0 29	0 30	0 32	0 33	0 33	0 33	0 32	0 30	0 29	0 28	3 0
3 12	0 29	0 29	0 31	0 32	0 34	0 35	0 35	0 35	0 34	0 32	0 31	0 30	3 12
3 24	0 31	0 31	0 33	0 34	0 36	0 37	0 38	0 37	0 36	0 35	0 33	0 32	3 24
3 36	0 32	0 33	0 34	0 36	0 38	0 39	0 40	0 40	0 38	0 37	0 35	0 34	3 36
3 48	0 34	0 35	0 36	0 38	0 40	0 42	0 42	0 42	0 40	0 39	0 37	0 36	3 48
4 0	0 36	0 37	0 38	0 40	0 42	0 44	0 44	0 44	0 43	0 41	0 39	0 37	4 0
4 12	0 38	0 39	0 40	0 42	0 44	0 46	0 47	0 46	0 45	0 43	0 41	0 39	4 12
4 24	0 40	0 40	0 42	0 44	0 47	0 48	0 49	0 48	0 47	0 45	0 43	0 41	4 24
4 36	0 41	0 42	0 44	0 46	0 49	0 50	0 51	0 51	0 49	0 47	0 44	0 43	4 36
4 48	0 43	0 44	0 46	0 48	0 51	0 53	0 53	0 53	0 51	0 49	0 46	0 45	4 48
5 0	0 45	0 46	0 48	0 50	0 53	0 55	0 56	0 55	0 53	0 51	0 48	0 47	5 0
5 12	0 47	0 48	0 50	0 52	0 55	0 57	0 58	0 57	0 55	0 53	0 50	0 49	5 12
5 24	0 49	0 50	0 52	0 54	0 57	0 59	1 0	0 59	0 58	0 55	0 52	0 51	5 24
5 36	0 50	0 51	0 54	0 56	0 59	1 1	1 2	1 2	1 0	0 57	0 54	0 52	5 36
5 48	0 52	0 53	0 56	0 59	1 1	1 4	1 4	1 4	1 2	0 59	0 56	0 54	5 48
6 0	0 54	0 55	0 58	1 1	1 4	1 6	1 7	1 6	1 4	1 1	0 58	0 56	6 0
6 12	0 56	0 57	0 59	1 3	1 6	1 8	1 9	1 8	1 6	1 3	1 0	0 58	6 12
6 24	0 58	0 59	1 1	1 5	1 8	1 10	1 11	1 10	1 8	1 5	1 2	1 0	6 24
6 36	0 59	1 1	1 3	1 7	1 10	1 12	1 13	1 13	1 10	1 7	1 4	1 2	6 36
6 48	1 1	1 2	1 5	1 9	1 12	1 15	1 16	1 15	1 12	1 9	1 6	1 4	6 48
7 0	1 3	1 4	1 7	1 11	1 14	1 17	1 18	1 17	1 14	1 11	1 8	1 6	7 0
7 12	1 5	1 6	1 9	1 13	1 16	1 19	1 20	1 19	1 17	1 13	1 10	1 7	7 12
7 24	1 7	1 8	1 11	1 15	1 18	1 21	1 22	1 21	1 19	1 15	1 12	1 9	7 24
7 36	1 8	1 10	1 13	1 17	1 20	1 23	1 24	1 24	1 21	1 17	1 14	1 11	7 36
7 48	1 10	1 12	1 15	1 19	1 23	1 25	1 27	1 26	1 23	1 19	1 16	1 13	7 48
8 0	1 12	1 13	1 17	1 21	1 25	1 28	1 29	1 28	1 25	1 21	1 17	1 15	8 0
8 12	1 14	1 15	1 19	1 23	1 27	1 30	1 31	1 30	1 27	1 23	1 19	1 17	8 12
8 24	1 16	1 17	1 21	1 25	1 29	1 32	1 33	1 32	1 29	1 25	1 21	1 19	8 24
8 36	1 17	1 19	1 22	1 27	1 31	1 34	1 36	1 35	1 32	1 27	1 23	1 21	8 36
8 48	1 19	1 21	1 24	1 29	1 33	1 36	1 38	1 37	1 34	1 29	1 25	1 22	8 48
9 0	1 21	1 23	1 26	1 31	1 35	1 39	1 40	1 39	1 36	1 31	1 27	1 24	9 0
9 12	1 23	1 25	1 28	1 33	1 37	1 41	1 42	1 41	1 38	1 33	1 29	1 26	9 12
9 24	1 25	1 26	1 30	1 35	1 40	1 43	1 44	1 43	1 40	1 36	1 31	1 28	9 24
9 36	1 26	1 28	1 32	1 37	1 42	1 45	1 47	1 46	1 42	1 38	1 33	1 30	9 36
9 48	1 28	1 30	1 34	1 39	1 44	1 47	1 49	1 48	1 44	1 40	1 35	1 32	9 48
10 0	1 30	1 32	1 36	1 41	1 46	1 50	1 51	1 50	1 46	1 42	1 37	1 34	10 0
10 12	1 32	1 34	1 38	1 43	1 48	1 52	1 53	1 52	1 49	1 44	1 39	1 36	10 12
10 24	1 34	1 36	1 40	1 45	1 50	1 54	1 56	1 54	1 51	1 46	1 41	1 38	10 24
10 36	1 35	1 37	1 42	1 47	1 52	1 56	1 58	1 57	1 53	1 48	1 43	1 39	10 36
10 48	1 37	1 39	1 44	1 49	1 54	1 58	2 0	1 59	1 55	1 50	1 45	1 41	10 48
11 0	1 39	1 41	1 46	1 51	1 57	2 1	2 2	2 1	1 57	1 52	1 46	1 43	11 0
11 12	1 41	1 43	1 47	1 53	1 59	2 3	2 4	2 3	1 59	1 54	1 48	1 45	11 12
11 24	1 43	1 45	1 49	1 55	2 1	2 5	2 7	2 5	2 1	1 56	1 50	1 47	11 24
11 36	1 44	1 47	1 51	1 57	2 3	2 7	2 9	2 8	2 4	1 58	1 52	1 49	11 36
11 48	1 46	1 48	1 53	1 59	2 5	2 9	2 11	2 10	2 6	2 0	1 54	1 51	11 48
12 0	1 48	1 50	1 55	2 1	2 7	2 12	2 13	2 12	2 8	2 2	1 56	1 52	12 0

TABLE XXIII.

LOGARITHMIC SINES, TANGENTS, and SECANTS, to every Point and Quarter Point of the Compass.

Points.		Sine.	Co-sine.	Tangent.	Co-tang.	Secant.	Co-sec.	Points.	
0		0.000000	10.000000	0.000000	Infinite.	10.000000	Infinite.	8	
0	¼	8.690796	9.999477	8.691319	11.308681	10.000523	11.309204	7	¾
0	½	8.991302	9.997904	8.993398	11.006602	10.002096	11.008698	7	½
0	¾	9.166520	9.995274	9.171247	10.828753	10.004726	10.833480	7	¼
1		9.290236	9.991574	9.298662	10.701338	10.008426	10.709764	7	
1	¼	9.385571	9.986786	9.398785	10.601215	10.013214	10.614429	6	¾
1	½	9.462824	9.980885	9.481939	10.518061	10.019115	10.537176	6	½
1	¾	9.527488	9.973841	9.553647	10.446353	10.026159	10.472512	6	¼
2		9.582840	9.965615	9.617224	10.382776	10.034385	10.417160	6	
2	¼	9.630992	9.956163	9.674829	10.325171	10.043837	10.369008	5	¾
2	½	9.673387	9.945430	9.727957	10.272043	10.054570	10.326613	5	½
2	¾	9.711050	9.933350	9.777700	10.222300	10.066650	10.288950	5	¼
3		9.744739	9.919846	9.824893	10.175107	10.080154	10.255261	5	
3	¼	9.775027	9.904828	9.870199	10.129801	10.095172	10.224973	4	¾
3	½	9.802359	9.888185	9.914173	10.085827	10.111815	10.197641	4	½
3	¾	9.827084	9.869790	9.957295	10.042705	10.130210	10.172916	4	¼
4		9.849485	9.849485	10.000000	10.000000	10.150515	10.150515	4	
		Co-sine.	Sine.	Co-tang.	Tangent.	Co-sec.	Secant.		

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1——100 Log. 0.000000——2.000000

No.	Log.	No.	Log.	No.	Log.	No.	Log.	No.	Log.
1	0.000000	21	1.322219	41	1.612784	61	1.785330	81	1.908485
2	0.301030	22	1.342423	42	1.623249	62	1.792392	82	1.913814
3	0.477121	23	1.361728	43	1.633468	63	1.799341	83	1.919078
4	0.602060	24	1.380211	44	1.643453	64	1.806180	84	1.924279
5	0.698970	25	1.397940	45	1.653213	65	1.812913	85	1.929419
6	0.778151	26	1.414973	46	1.662758	66	1.819544	86	1.934498
7	0.845098	27	1.431364	47	1.672098	67	1.826075	87	1.939519
8	0.903090	28	1.447158	48	1.681241	68	1.832509	88	1.944483
9	0.954243	29	1.462398	49	1.690196	69	1.838849	89	1.949390
10	1.000000	30	1.477121	50	1.698970	70	1.845098	90	1.954243
11	1.041393	31	1.491362	51	1.707570	71	1.851258	91	1.959041
12	1.079181	32	1.505150	52	1.716003	72	1.857332	92	1.963788
13	1.113943	33	1.518514	53	1.724276	73	1.863323	93	1.968483
14	1.146128	34	1.531479	54	1.732394	74	1.869232	94	1.973128
15	1.176091	35	1.544068	55	1.740363	75	1.875061	95	1.977724
16	1.204120	36	1.556302	56	1.748188	76	1.880814	96	1.982271
17	1.230449	37	1.568202	57	1.755875	77	1.886491	97	1.986772
18	1.255273	38	1.579784	58	1.763428	78	1.892095	98	1.991226
19	1.278754	39	1.591065	59	1.770852	79	1.897627	99	1.995635
20	1.301030	40	1.602060	60	1.778151	80	1.903090	100	2.000000

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1000——1600 Log. 000000——204120

No.	0	1	2	3	4	5	6	7	8	9	Diff.
100	000000	000434	000868	001301	001734	002166	002598	003029	003460	003891	432
101	004321	004751	005180	005609	006038	006466	006894	007321	007748	008174	428
102	008600	009026	009451	009876	010300	010724	011147	011570	011993	012415	424
103	012837	013259	013680	014100	014520	014940	015360	015779	016197	016615	420
104	017033	017451	017868	018284	018700	019116	019532	019947	020361	020775	416
105	021189	021603	022016	022428	022841	023252	023664	024075	024486	024896	412
106	025306	025715	026124	026533	026942	027350	027757	028164	028571	028978	408
107	029384	029789	030195	030600	031004	031408	031812	032216	032619	033021	404
108	033424	033826	034227	034628	035029	035430	035830	036229	036629	037028	400
109	037426	037825	038223	038620	039017	039414	039811	040207	040602	040998	397
110	041393	041787	042182	042575	042969	043362	043755	044148	044540	044931	393
111	045323	045714	046105	046495	046885	047275	047664	048053	048442	048830	390
112	049218	049606	049993	050380	050766	051152	051538	051924	052309	052694	386
113	053078	053463	053846	054230	054613	054996	055378	055760	056142	056524	383
114	056905	057286	057666	058046	058426	058805	059185	059563	059942	060320	379
115	060698	061075	061452	061829	062206	062582	062958	063333	063709	064083	376
116	064458	064832	065206	065580	065953	066326	066699	067071	067443	067814	373
117	068186	068557	068928	069298	069668	070038	070407	070776	071145	071514	370
118	071882	072250	072617	072985	073352	073718	074085	074451	074816	075182	366
119	075547	075912	076276	076640	077004	077368	077731	078094	078457	078819	363
120	079181	079543	079904	080266	080626	080987	081347	081707	082067	082426	360
121	082785	083144	083503	083861	084219	084576	084934	085291	085647	086004	357
122	086360	086716	087071	087426	087781	088136	088490	088845	089198	089552	355
123	089905	090258	090611	090963	091315	091667	092018	092370	092721	093071	352
124	093422	093772	094122	094471	094820	095169	095518	095866	096215	096562	349
125	096910	097257	097604	097951	098297	098644	098990	099335	099681	100026	346
126	100370	100715	101059	101403	101747	102090	102434	102777	103119	103462	343
127	103804	104146	104487	104828	105169	105510	105851	106191	106531	106870	341
128	107210	107549	107888	108227	108565	108903	109241	109578	109916	110253	338
129	110590	110926	111262	111598	111934	112270	112605	112940	113275	113609	335
130	113943	114277	114611	114944	115278	115610	115943	116276	116608	116940	332
131	117271	117603	117934	118265	118595	118926	119256	119586	119915	120245	330
132	120574	120903	121231	121560	121888	122216	122543	122871	123198	123525	328
133	123852	124178	124504	124830	125156	125481	125806	126131	126456	126781	325
134	127105	127429	127752	128076	128399	128722	129045	129368	129690	130012	323
135	130334	130655	130977	131298	131619	131939	132260	132580	132900	133219	321
136	133539	133858	134177	134496	134814	135133	135451	135768	136086	136403	318
137	136721	137037	137354	137670	137987	138303	138618	138934	139249	139564	316
138	139879	140194	140508	140822	141136	141450	141763	142076	142389	142702	314
139	143015	143327	143639	143951	144263	144574	144885	145196	145507	145818	311
140	146128	146438	146748	147058	147367	147676	147985	148294	148603	148911	309
141	149219	149527	149835	150142	150449	150756	151063	151370	151676	151982	307
142	152288	152594	152900	153205	153510	153815	154119	154424	154728	155032	305
143	155336	155640	155943	156246	156549	156852	157154	157457	157759	158061	303
144	158362	158664	158965	159266	159567	159868	160168	160468	160769	161068	300
145	161368	161667	161967	162266	162564	162863	163161	163460	163757	164055	298
146	164353	164650	164947	165244	165541	165838	166134	166430	166726	167022	296
147	167317	167613	167908	168203	168497	168792	169086	169380	169674	169968	294
148	170262	170555	170848	171141	171434	171726	172019	172311	172603	172895	292
149	173186	173478	173769	174060	174351	174641	174932	175222	175512	175802	290
150	176091	176381	176670	176959	177248	177536	177825	178113	178401	178689	288
151	178977	179264	179552	179839	180126	180413	180699	180986	181272	181558	287
152	181844	182129	182415	182700	182985	183270	183554	183839	184123	184407	285
153	184691	184975	185259	185542	185825	186108	186391	186674	186956	187239	283
154	187521	187803	188084	188366	188647	188928	189209	189490	189771	190051	281
155	190332	190612	190892	191171	191451	191730	192010	192289	192567	192846	279
156	193125	193403	193681	193959	194237	194514	194792	195069	195346	195623	278
157	195900	196176	196452	196729	197005	197281	197556	197832	198107	198382	276
158	198657	198932	199206	199481	199755	200029	200303	200577	200850	201124	274
159	201397	201670	201943	202216	202488	202761	203033	203305	203577	203848	272
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 1600———2200 Log. 204120———342423

No.	0	1	2	3	4	5	6	7	8	9	Diff.
160	204120	204391	204662	204933	205204	205475	205745	206016	206286	206556	271
161	206826	207095	207365	207634	207903	208172	208441	208710	208978	209247	269
162	209515	209783	210051	210318	210586	210853	211120	211388	211654	211921	267
163	212188	212454	212720	212986	213252	213518	213783	214049	214314	214579	266
164	214844	215109	215373	215638	215902	216166	216430	216694	216957	217221	264
165	217484	217747	218010	218273	218535	218798	219060	219322	219584	219846	262
166	220108	220370	220631	220892	221153	221414	221675	221936	222196	222456	261
167	222716	222976	223236	223496	223755	224015	224274	224533	224792	225051	259
168	225309	225568	225826	226084	226342	226600	226858	227115	227372	227630	258
169	227887	228144	228400	228657	228913	229170	229426	229682	229938	230193	256
170	230449	230704	230960	231215	231470	231724	231979	232233	232488	232742	255
171	232996	233250	233504	233757	234011	234264	234517	234770	235023	235276	253
172	235528	235781	236033	236285	236537	236789	237041	237292	237544	237795	252
173	238046	238297	238548	238799	239049	239299	239550	239800	240050	240300	250
174	240549	240799	241048	241297	241546	241795	242044	242293	242541	242790	249
175	243038	243286	243534	243782	244030	244277	244524	244772	245019	245266	247
176	245513	245759	246006	246252	246499	246745	246991	247236	247482	247728	246
177	247973	248219	248464	248709	248954	249198	249443	249687	249932	250176	245
178	250420	250664	250908	251151	251395	251638	251881	252125	252367	252610	243
179	252853	253096	253338	253580	253822	254064	254306	254548	254790	255031	242
180	255273	255514	255755	255996	256236	256477	256718	256958	257198	257439	241
181	257679	257918	258158	258398	258637	258877	259116	259355	259594	259833	239
182	260071	260310	260548	260787	261025	261263	261501	261738	261976	262214	238
183	262451	262688	262925	263162	263399	263636	263873	264109	264345	264582	237
184	264818	265054	265290	265525	265761	265996	266232	266467	266702	266937	235
185	267172	267406	267641	267875	268110	268344	268578	268812	269046	269279	234
186	269513	269746	269980	270213	270446	270679	270912	271144	271377	271609	233
187	271842	272074	272306	272538	272770	273001	273233	273464	273696	273927	232
188	274158	274389	274620	274850	275081	275311	275542	275772	276002	276232	230
189	276462	276691	276921	277151	277380	277609	277838	278067	278296	278525	229
190	278754	278982	279210	279439	279667	279895	280123	280351	280578	280806	228
191	281033	281261	281488	281715	281942	282169	282395	282622	282849	283075	227
192	283301	283527	283753	283979	284205	284431	284656	284882	285107	285332	226
193	285557	285782	286007	286232	286456	286681	286905	287130	287354	287578	225
194	287802	288025	288249	288473	288696	288920	289143	289366	289589	289812	223
195	290035	290257	290480	290702	290925	291147	291369	291591	291813	292034	222
196	292256	292478	292699	292920	293141	293363	293583	293804	294025	294246	221
197	294466	294687	294907	295127	295347	295567	295787	296007	296226	296446	220
198	296665	296884	297104	297323	297542	297761	297979	298198	298416	298635	219
199	298853	299071	299289	299507	299725	299943	300161	300378	300595	300813	218
200	301030	301247	301464	301681	301898	302114	302331	302547	302764	302980	217
201	303196	303412	303628	303844	304059	304275	304491	304706	304921	305136	216
202	305351	305566	305781	305996	306211	306425	306639	306854	307068	307282	214
203	307496	307710	307924	308137	308351	308564	308778	308991	309204	309417	213
204	309630	309843	310056	310268	310481	310693	310906	311118	311330	311542	212
205	311754	311966	312177	312389	312600	312812	313023	313234	313445	313656	211
206	313867	314078	314289	314499	314710	314920	315130	315340	315550	315760	210
207	315970	316180	316390	316599	316809	317018	317227	317436	317645	317854	209
208	318063	318272	318481	318689	318898	319106	319314	319522	319730	319938	208
209	320146	320354	320562	320769	320977	321184	321391	321598	321805	322012	207
210	322219	322426	322633	322839	323046	323252	323458	323665	323871	324077	206
211	324282	324488	324694	324899	325105	325310	325516	325721	325926	326131	205
212	326336	326541	326745	326950	327155	327359	327563	327767	327972	328176	204
213	328380	328583	328787	328991	329194	329398	329601	329805	330008	330211	203
214	330414	330617	330819	331022	331225	331427	331630	331832	332034	332236	202
215	332438	332640	332842	333044	333246	333447	333649	333850	334051	334253	202
216	334454	334655	334856	335056	335257	335458	335658	335859	336059	336260	201
217	336460	336660	336860	337060	337260	337459	337659	337858	338058	338257	200
218	338456	338656	338855	339054	339253	339451	339650	339849	340047	340246	199
219	340444	340642	340841	341039	341237	341435	341632	341830	342028	342225	198
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 2200———2800 Log. 342423———447158.

No.	0	1	2	3	4	5	6	7	8	9	Diff.
220	342423	342620	342817	343014	343212	343409	343606	343802	343999	344196	197
221	344392	344589	344785	344981	345178	345374	345570	345766	345962	346157	196
222	346353	346549	346744	346939	347135	347330	347525	347720	347915	348110	195
223	348305	348500	348694	348889	349083	349278	349472	349666	349860	350054	194
224	350248	350442	350636	350829	351023	351216	351410	351603	351796	351989	193
225	352182	352375	352568	352761	352954	353147	353339	353532	353724	353916	193
226	354108	354301	354493	354685	354876	355068	355260	355452	355643	355834	192
227	356026	356217	356408	356599	356790	356981	357172	357363	357554	357744	191
228	357935	358125	358316	358506	358696	358886	359076	359266	359456	359646	190
229	359835	360025	360215	360404	360593	360783	360972	361161	361350	361539	189
230	361728	361917	362105	362294	362482	362671	362859	363048	363236	363424	188
231	363612	363800	363988	364176	364363	364551	364739	364926	365113	365301	188
232	365488	365675	365862	366049	366236	366423	366610	366796	366983	367169	187
233	367356	367542	367729	367915	368101	368287	368473	368659	368844	369030	186
234	369216	369401	369587	369772	369958	370143	370328	370513	370698	370883	185
235	371068	371253	371437	371622	371806	371991	372175	372360	372544	372728	184
236	372912	373096	373280	373464	373647	373831	374015	374198	374382	374565	184
237	374748	374932	375115	375298	375481	375664	375846	376029	376212	376394	183
238	376577	376759	376942	377124	377306	377488	377670	377852	378034	378216	182
239	378398	378580	378761	378943	379124	379306	379487	379668	379849	380030	181
240	380211	380392	380573	380754	380934	381115	381296	381476	381656	381837	181
241	382017	382197	382377	382557	382737	382917	383097	383277	383456	383636	180
242	383815	383995	384174	384353	384533	384712	384891	385070	385249	385428	179
243	385606	385785	385964	386142	386321	386499	386677	386856	387034	387212	178
244	387390	387568	387746	387923	388101	388279	388456	388634	388811	388989	178
245	389166	389343	389520	389697	389875	390051	390228	390405	390582	390759	177
246	390935	391112	391288	391464	391641	391817	391993	392169	392345	392521	176
247	392697	392873	393048	393224	393400	393575	393751	393926	394101	394277	176
248	394452	394627	394802	394977	395152	395326	395501	395676	395850	396025	175
249	396199	396374	396548	396722	396896	397071	397245	397418	397592	397766	174
250	397940	398114	398287	398461	398634	398808	398981	399154	399327	399501	173
251	399674	399847	400020	400192	400365	400538	400711	400883	401056	401228	173
252	401400	401573	401745	401917	402089	402261	402433	402605	402777	402949	172
253	403120	403292	403464	403635	403807	403978	404149	404320	404492	404663	171
254	404834	405005	405175	405346	405517	405688	405858	406029	406199	406370	171
255	406540	406710	406881	407051	407221	407391	407561	407731	407900	408070	170
256	408240	408410	408579	408749	408918	409087	409257	409426	409595	409764	169
257	409933	410102	410271	410440	410608	410777	410946	411114	411283	411451	169
258	411620	411788	411956	412124	412292	412460	412628	412796	412964	413132	168
259	413300	413467	413635	413802	413970	414137	414305	414472	414639	414806	167
260	414973	415140	415307	415474	415641	415808	415974	416141	416308	416474	167
261	416640	416807	416973	417139	417306	417472	417638	417804	417970	418135	166
262	418301	418467	418633	418798	418964	419129	419295	419460	419625	419791	165
263	419956	420121	420286	420451	420616	420781	420945	421110	421275	421439	165
264	421604	421768	421933	422097	422261	422426	422590	422754	422918	423082	164
265	423246	423410	423573	423737	423901	424064	424228	424392	424555	424718	164
266	424882	425045	425208	425371	425534	425697	425860	426023	426186	426349	163
267	426511	426674	426836	426999	427161	427324	427486	427648	427811	427973	162
268	428135	428297	428459	428621	428782	428944	429106	429268	429429	429591	162
269	429752	429914	430075	430236	430398	430559	430720	430881	431042	431203	161
270	431364	431525	431685	431846	432007	432167	432328	432488	432649	432809	160
271	432969	433129	433290	433450	433610	433770	433930	434090	434249	434409	160
272	434569	434728	434888	435048	435207	435366	435526	435685	435844	436003	159
273	436163	436322	436481	436640	436798	436957	437116	437275	437433	437592	159
274	437751	437909	438067	438226	438384	438542	438700	438859	439017	439175	158
275	439333	439491	439648	439806	439964	440122	440279	440437	440594	440752	158
276	440909	441066	441224	441381	441538	441695	441852	442009	442166	442323	157
277	442480	442636	442793	442950	443106	443263	443419	443576	443732	443888	157
278	444045	444201	444357	444513	444669	444825	444981	445137	445293	445448	156
279	445604	445760	445915	446071	446226	446382	446537	446692	446848	447003	155
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 2800——3400 Log. 447158——531479

No.	0	1	2	3	4	5	6	7	8	9	Diff.
280	447158	447313	447468	447623	447778	447933	448088	448242	448397	448552	155
281	448706	448861	449015	449170	449324	449478	449633	449787	449941	450095	154
282	450249	450403	450557	450711	450865	451018	451172	451326	451479	451633	154
283	451786	451940	452093	452247	452400	452553	452706	452859	453012	453165	153
284	453318	453471	453624	453777	453930	454082	454235	454387	454540	454692	153
285	454845	454997	455149	455302	455454	455606	455758	455910	456062	456214	152
286	456366	456518	456670	456821	456973	457125	457276	457428	457579	457730	152
287	457882	458033	458184	458336	458487	458638	458789	458940	459091	459242	151
288	459392	459543	459694	459845	459995	460146	460296	460447	460597	460747	151
289	460898	461048	461198	461348	461498	461649	461799	461948	462098	462248	150
290	462398	462548	462697	462847	462997	463146	463296	463445	463594	463744	150
291	463893	464042	464191	464340	464489	464639	464787	464936	465085	465234	149
292	465383	465532	465680	465829	465977	466126	466274	466423	466571	466719	149
293	466868	467016	467164	467312	467460	467608	467756	467904	468052	468200	148
294	468347	468495	468643	468790	468938	469085	469233	469380	469527	469675	148
295	469822	469969	470116	470263	470410	470557	470704	470851	470998	471145	147
296	471292	471438	471585	471732	471878	472025	472171	472317	472464	472610	147
297	472756	472903	473049	473195	473341	473487	473633	473779	473925	474070	146
298	474216	474362	474508	474653	474799	474944	475090	475235	475381	475526	146
299	475671	475816	475962	476107	476252	476397	476542	476687	476832	476976	145
300	477121	477266	477411	477555	477700	477844	477989	478133	478278	478422	145
301	478566	478711	478855	478999	479143	479287	479431	479575	479719	479863	144
302	480007	480151	480294	480438	480582	480725	480869	481012	481156	481299	144
303	481443	481586	481729	481872	482016	482159	482302	482445	482588	482731	143
304	482874	483016	483159	483302	483445	483587	483730	483872	484015	484157	143
305	484300	484442	484584	484727	484869	485011	485153	485295	485437	485579	142
306	485721	485863	486005	486147	486289	486430	486572	486714	486855	486997	142
307	487138	487280	487421	487563	487704	487845	487986	488127	488269	488410	141
308	488551	488692	488833	488973	489114	489255	489396	489537	489677	489818	141
309	489958	490099	490239	490380	490520	490661	490801	490941	491081	491222	140
310	491362	491502	491642	491782	491922	492062	492201	492341	492481	492621	140
311	492760	492900	493040	493179	493319	493458	493597	493737	493876	494015	139
312	494155	494294	494433	494572	494711	494850	494989	495128	495267	495406	139
313	495544	495683	495822	495960	496099	496237	496376	496514	496653	496791	139
314	496930	497068	497206	497344	497482	497621	497759	497897	498035	498173	138
315	498311	498448	498586	498724	498862	498999	499137	499275	499412	499550	138
316	499687	499824	499962	500099	500236	500374	500511	500648	500785	500922	137
317	501059	501196	501333	501470	501607	501744	501880	502017	502154	502290	137
318	502427	502564	502700	502837	502973	503109	503246	503382	503518	503654	136
319	503791	503927	504063	504199	504335	504471	504607	504743	504878	505014	136
320	505150	505286	505421	505557	505692	505828	505963	506099	506234	506370	136
321	506505	506640	506775	506911	507046	507181	507316	507451	507586	507721	135
322	507856	507991	508125	508260	508395	508530	508664	508799	508933	509068	135
323	509202	509337	509471	509606	509740	509874	510008	510143	510277	510411	134
324	510545	510679	510813	510947	511081	511215	511348	511482	511616	511750	134
325	511883	512017	512150	512284	512417	512551	512684	512818	512951	513084	133
326	513218	513351	513484	513617	513750	513883	514016	514149	514282	514415	133
327	514548	514680	514813	514946	515079	515211	515344	515476	515609	515741	133
328	515874	516006	516139	516271	516403	516535	516668	516800	516932	517064	132
329	517196	517328	517460	517592	517724	517855	517987	518119	518251	518382	132
330	518514	518645	518777	518909	519040	519171	519303	519434	519565	519697	131
331	519828	519959	520090	520221	520352	520483	520614	520745	520876	521007	131
332	521138	521269	521400	521530	521661	521792	521922	522053	522183	522314	131
333	522444	522575	522705	522835	522966	523096	523226	523356	523486	523616	130
334	523746	523876	524006	524136	524266	524396	524526	524656	524785	524915	130
335	525045	525174	525304	525434	525563	525693	525822	525951	526081	526210	129
336	526339	526468	526598	526727	526856	526985	527114	527243	527372	527501	129
337	527630	527759	527888	528016	528145	528274	528402	528531	528660	528788	129
338	528917	529045	529174	529302	529430	529559	529687	529815	529943	530072	128
339	530200	530328	530456	530584	530712	530840	530968	531095	531223	531351	128
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 3400— —4000 Log. 531479——602060

No.	0	1	2	3	4	5	6	7	8	9	Diff.
340	531479	531607	531734	531862	531990	532117	532245	532372	532500	532627	128
341	532754	532882	533009	533136	533263	533391	533518	533645	533772	533899	127
342	534026	534153	534280	534407	534534	534661	534787	534914	535041	535167	127
343	535294	535421	535547	535674	535800	535927	536053	536179	536306	536432	126
344	536558	536685	536811	536937	537063	537189	537315	537441	537567	537693	126
345	537819	537945	538071	538197	538322	538448	538574	538699	538825	538951	126
346	539076	539202	539327	539452	539578	539703	539829	539954	540079	540204	125
347	540329	540455	540580	540705	540830	540955	541080	541205	541330	541454	125
348	541579	541704	541829	541953	542078	542203	542327	542452	542576	542701	125
349	542825	542950	543074	543199	543323	543447	543571	543696	543820	543944	124
350	544068	544192	544316	544440	544564	544688	544812	544936	545060	545183	124
351	545307	545431	545554	545678	545802	545925	546049	546172	546296	546419	124
352	546543	546666	546789	546913	547036	547159	547282	547405	547529	547652	123
353	547775	547898	548021	548144	548266	548389	548512	548635	548758	548881	123
354	549003	549126	549249	549371	549494	549616	549739	549861	549984	550106	123
355	550228	550351	550473	550595	550717	550840	550962	551084	551206	551328	122
356	551450	551572	551694	551816	551938	552059	552181	552303	552425	552546	122
357	552668	552790	552911	553033	553154	553276	553398	553519	553640	553762	121
358	553883	554004	554126	554247	554368	554489	554610	554731	554852	554973	121
359	555094	555215	555336	555457	555578	555699	555820	555940	556061	556182	121
360	556302	556423	556544	556664	556785	556905	557026	557146	557267	557387	120
361	557507	557627	557748	557868	557988	558108	558228	558348	558469	558589	120
362	558709	558829	558948	559068	559188	559308	559428	559548	559667	559787	120
363	559907	560026	560146	560265	560385	560504	560624	560743	560863	560982	119
364	561101	561221	561340	561459	561578	561698	561817	561936	562055	562174	119
365	562293	562412	562531	562650	562769	562887	563006	563125	563244	563362	119
366	563481	563600	563718	563837	563955	564074	564192	564311	564429	564548	119
367	564666	564784	564903	565021	565139	565257	565376	565494	565612	565730	118
368	565848	565966	566084	566202	566320	566437	566555	566673	566791	566909	118
369	567026	567144	567262	567379	567497	567614	567732	567849	567967	568084	118
370	568202	568319	568436	568554	568671	568788	568905	569023	569140	569257	117
371	569374	569491	569608	569725	569842	569959	570076	570193	570309	570426	117
372	570543	570660	570776	570893	571010	571126	571243	571359	571476	571592	117
373	571709	571825	571942	572058	572174	572291	572407	572523	572639	572755	116
374	572872	572988	573104	573220	573336	573452	573568	573684	573800	573915	116
375	574031	574147	574263	574379	574494	574610	574726	574841	574957	575072	116
376	575188	575303	575419	575534	575650	575765	575880	575996	576111	576226	115
377	576341	576457	576572	576687	576802	576917	577032	577147	577262	577377	115
378	577492	577607	577721	577836	577951	578066	578181	578295	578410	578525	115
379	578639	578754	578868	578983	579097	579212	579326	579441	579555	579669	114
380	579784	579898	580012	580126	580240	580355	580469	580583	580697	580811	114
381	580925	581039	581153	581267	581381	581495	581608	581722	581836	581950	114
382	582063	582177	582291	582404	582518	582631	582745	582858	582972	583085	114
383	583199	583312	583426	583539	583652	583765	583879	583992	584105	584218	113
384	584331	584444	584557	584670	584783	584896	585009	585122	585235	585348	113
385	585461	585574	585686	585799	585912	586024	586137	586250	586362	586475	113
386	586587	586700	586812	586925	587037	587149	587262	587374	587486	587599	112
387	587711	587823	587935	588047	588160	588272	588384	588496	588608	588720	112
388	588832	588944	589056	589167	589279	589391	589503	589615	589726	589838	112
389	589950	590061	590173	590284	590396	590507	590619	590730	590842	590953	112
390	591065	591176	591287	591399	591510	591621	591732	591843	591955	592066	111
391	592177	592288	592399	592510	592621	592732	592843	592954	593064	593175	111
392	593286	593397	593508	593618	593729	593840	593950	594061	594171	594282	111
393	594393	594503	594613	594724	594834	594945	595055	595165	595276	595386	110
394	595496	595606	595717	595827	595937	596047	596157	596267	596377	596487	110
395	596597	596707	596817	596927	597037	597146	597256	597366	597476	597585	110
396	597695	597805	597914	598024	598134	598243	598353	598462	598572	598681	110
397	598790	598900	599009	599119	599228	599337	599446	599556	599665	599774	109
398	599883	599992	600101	600210	600319	600428	600537	600646	600755	600864	109
399	600973	601082	601190	601299	601408	601517	601625	601734	601843	601951	109
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 4000——4600 Log. 602060——662758

No.	0	1	2	3	4	5	6	7	8	9	Diff.
400	602060	602169	602277	602386	602494	602603	602711	602819	602928	603036	108
401	603144	603253	603361	603469	603577	603686	603794	603902	604010	604118	108
402	604226	604334	604442	604550	604658	604766	604874	604982	605089	605197	108
403	605305	605413	605521	605628	605736	605844	605951	606059	606166	606274	108
404	606381	606489	606596	606704	606811	606919	607026	607133	607241	607348	107
405	607455	607562	607669	607777	607884	607991	608098	608205	608312	608419	107
406	608526	608633	608740	608847	608954	609061	609167	609274	609381	609488	107
407	609594	609701	609808	609914	610021	610128	610234	610341	610447	610554	107
408	610660	610767	610873	610979	611086	611192	611298	611405	611511	611617	106
409	611723	611829	611936	612042	612148	612254	612360	612466	612572	612678	106
410	612784	612890	612996	613101	613207	613313	613419	613525	613630	613736	106
411	613842	613947	614053	614159	614264	614370	614475	614581	614686	614792	106
412	614897	615003	615108	615213	615319	615424	615529	615634	615740	615845	105
413	615950	616055	616160	616265	616370	616475	616580	616685	616790	616895	105
414	617000	617105	617210	617315	617420	617524	617629	617734	617839	617943	105
415	618048	618153	618257	618362	618466	618571	618675	618780	618884	618989	105
416	619093	619198	619302	619406	619511	619615	619719	619823	619928	620032	104
417	620136	620240	620344	620448	620552	620656	620760	620864	620968	621072	104
418	621176	621280	621384	621488	621592	621695	621799	621903	622007	622110	104
419	622214	622318	622421	622525	622628	622732	622835	622939	623042	623146	104
420	623249	623353	623456	623559	623663	623766	623869	623972	624076	624179	103
421	624282	624385	624488	624591	624694	624798	624901	625004	625107	625209	103
422	625312	625415	625518	625621	625724	625827	625929	626032	626135	626238	103
423	626340	626443	626546	626648	626751	626853	626956	627058	627161	627263	103
424	627366	627468	627571	627673	627775	627878	627980	628082	628184	628287	102
425	628389	628491	628593	628695	628797	628900	629002	629104	629206	629308	102
426	629410	629511	629613	629715	629817	629919	630021	630123	630224	630326	102
427	630428	630530	630631	630733	630834	630936	631038	631139	631241	631342	102
428	631444	631545	631647	631748	631849	631951	632052	632153	632255	632356	101
429	632457	632558	632660	632761	632862	632963	633064	633165	633266	633367	101
430	633468	633569	633670	633771	633872	633973	634074	634175	634276	634376	101
431	634477	634578	634679	634779	634880	634981	635081	635182	635283	635383	101
432	635484	635584	635685	635785	635886	635986	636086	636187	636287	636388	100
433	636488	636588	636688	636789	636889	636989	637089	637189	637289	637390	100
434	637490	637590	637690	637790	637890	637990	638090	638190	638289	638389	100
435	638489	638589	638689	638789	638888	638988	639088	639188	639287	639387	100
436	639486	639586	639686	639785	639885	639984	640084	640183	640283	640382	99
437	640481	640581	640680	640779	640879	640978	641077	641176	641276	641375	99
438	641474	641573	641672	641771	641870	641970	642069	642168	642267	642366	99
439	642464	642563	642662	642761	642860	642959	643058	643156	643255	643354	99
440	643453	643551	643650	643749	643847	643946	644044	644143	644242	644340	98
441	644439	644537	644635	644734	644832	644931	645029	645127	645226	645324	98
442	645422	645520	645619	645717	645815	645913	646011	646109	646208	646306	98
443	646404	646502	646600	646698	646796	646894	646991	647089	647187	647285	98
444	647383	647481	647579	647676	647774	647872	647969	648067	648165	648262	98
445	648360	648458	648555	648653	648750	648848	648945	649043	649140	649237	97
446	649335	649432	649530	649627	649724	649821	649919	650016	650113	650210	97
447	650307	650405	650502	650599	650696	650793	650890	650987	651084	651181	97
448	651278	651375	651472	651569	651666	651762	651859	651956	652053	652150	97
449	652246	652343	652440	652536	652633	652730	652826	652923	653019	653116	97
450	653213	653309	653405	653502	653598	653695	653791	653888	653984	654080	96
451	654176	654273	654369	654465	654562	654658	654754	654850	654946	655042	96
452	655138	655234	655331	655427	655523	655619	655714	655810	655906	656002	96
453	656098	656194	656290	656386	656481	656577	656673	656769	656864	656960	96
454	657056	657151	657247	657343	657438	657534	657629	657725	657820	657916	96
455	658011	658107	658202	658298	658393	658488	658584	658679	658774	658870	95
456	658965	659060	659155	659250	659346	659441	659536	659631	659726	659821	95
457	659916	660011	660106	660201	660296	660391	660486	660581	660676	660771	95
458	660865	660960	661055	661150	661245	661339	661434	661529	661623	661718	95
459	661813	661907	662002	662096	662191	662285	662380	662474	662569	662663	95
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 4600——5200 Log. 662758——716003.

No.	0	1	2	3	4	5	6	7	8	9	Diff.
460	662758	662852	662947	663041	663135	663230	663324	663418	663512	663607	94
461	663701	663795	663889	663983	664078	664172	664266	664360	664454	664548	94
462	664642	664736	664830	664924	665018	665112	665206	665299	665393	665487	94
463	665581	665675	665769	665862	665956	666050	666143	666237	666331	666424	94
464	666518	666612	666705	666799	666892	666986	667079	667173	667266	667359	94
465	667453	667546	667640	667733	667826	667920	668013	668106	668199	668293	93
466	668386	668479	668572	668665	668758	668852	668945	669038	669131	669224	93
467	669317	669410	669503	669596	669689	669782	669875	669967	670060	670153	93
468	670246	670339	670431	670524	670617	670710	670802	670895	670988	671080	93
469	671173	671265	671358	671451	671543	671636	671728	671821	671913	672005	93
470	672098	672190	672283	672375	672467	672560	672652	672744	672836	672929	92
471	673021	673113	673205	673297	673390	673482	673574	673666	673758	673850	92
472	673942	674034	674126	674218	674310	674402	674494	674586	674677	674769	92
473	674861	674953	675045	675136	675228	675320	675412	675503	675595	675687	92
474	675778	675870	675962	676053	676145	676236	676328	676419	676511	676602	92
475	676694	676785	676876	676968	677059	677151	677242	677333	677424	677516	91
476	677607	677698	677789	677881	677972	678063	678154	678245	678336	678427	91
477	678518	678609	678700	678791	678882	678973	679064	679155	679246	679337	91
478	679428	679519	679610	679700	679791	679882	679973	680063	680154	680245	91
479	680335	680426	680517	680607	680698	680789	680879	680970	681060	681151	91
480	681241	681332	681422	681513	681603	681693	681784	681874	681964	682055	90
481	682145	682235	682326	682416	682506	682596	682686	682777	682867	682957	90
482	683047	683137	683227	683317	683407	683497	683587	683677	683767	683857	90
483	683947	684037	684127	684217	684307	684396	684486	684576	684666	684756	90
484	684845	684935	685025	685114	685204	685294	685383	685473	685563	685652	90
485	685742	685831	685921	686010	686100	686189	686279	686368	686457	686547	89
486	686636	686726	686815	686904	686994	687083	687172	687261	687351	687440	89
487	687529	687618	687707	687796	687886	687975	688064	688153	688242	688331	89
488	688420	688509	688598	688687	688776	688865	688953	689042	689131	689220	89
489	689309	689398	689486	689575	689664	689753	689841	689930	690019	690107	89
490	690196	690285	690373	690462	690550	690639	690727	690816	690905	690993	89
491	691081	691170	691258	691347	691435	691524	691612	691700	691789	691877	88
492	691965	692053	692142	692230	692318	692406	692494	692583	692671	692759	88
493	692847	692935	693023	693111	693199	693287	693375	693463	693551	693639	88
494	693727	693815	693903	693991	694078	694166	694254	694342	694430	694517	88
495	694605	694693	694781	694868	694956	695044	695131	695219	695307	695394	88
496	695482	695569	695657	695744	695832	695919	696007	696094	696182	696269	87
497	696356	696444	696531	696618	696706	696793	696880	696968	697055	697142	87
498	697229	697317	697404	697491	697578	697665	697752	697839	697926	698013	87
499	698100	698188	698275	698362	698448	698535	698622	698709	698796	698883	87
500	698970	699057	699144	699231	699317	699404	699491	699578	699664	699751	87
501	699838	699924	700011	700098	700184	700271	700358	700444	700531	700617	87
502	700704	700790	700877	700963	701050	701136	701222	701309	701395	701482	86
503	701568	701654	701741	701827	701913	701999	702086	702172	702258	702344	86
504	702430	702517	702603	702689	702775	702861	702947	703033	703119	703205	86
505	703291	703377	703463	703549	703635	703721	703807	703893	703979	704065	86
506	704150	704236	704322	704408	704494	704579	704665	704751	704837	704922	86
507	705008	705094	705179	705265	705350	705436	705522	705607	705693	705778	86
508	705864	705949	706035	706120	706206	706291	706376	706462	706547	706632	85
509	706718	706803	706888	706974	707059	707144	707229	707315	707400	707485	85
510	707570	707655	707740	707826	707911	707996	708081	708166	708251	708336	85
511	708421	708506	708591	708676	708761	708846	708931	709015	709100	709185	85
512	709270	709355	709440	709524	709609	709694	709779	709863	709948	710033	85
513	710117	710202	710287	710371	710456	710540	710625	710710	710794	710879	85
514	710963	711048	711132	711216	711301	711385	711470	711554	711638	711723	84
515	711807	711892	711976	712060	712144	712229	712313	712397	712481	712566	84
516	712650	712734	712818	712902	712986	713070	713154	713238	713322	713406	84
517	713490	713574	713658	713742	713826	713910	713994	714078	714162	714246	84
518	714330	714414	714497	714581	714665	714749	714832	714916	715000	715084	84
519	715167	715251	715335	715418	715502	715586	715669	715753	715836	715920	84
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 5200——5800 Log. 716003——763428

No.	0	1	2	3	4	5	6	7	8	9	Diff
520	716003	716087	716170	716254	716337	716421	716504	716588	716671	716754	83
521	716838	716921	717004	717088	717171	717254	717338	717421	717504	717587	83
522	717671	717754	717837	717920	718003	718086	718169	718253	718336	718419	83
523	718502	718585	718668	718751	718834	718917	719000	719083	719165	719248	83
524	719331	719414	719497	719580	719663	719745	719828	719911	719994	720077	83
525	720159	720242	720325	720407	720490	720573	720655	720738	720821	720903	83
526	720986	721068	721151	721233	721316	721398	721481	721563	721646	721728	82
527	721811	721893	721975	722058	722140	722222	722305	722387	722469	722552	82
528	722634	722716	722798	722881	722963	723045	723127	723209	723291	723374	82
529	723456	723538	723620	723702	723784	723866	723948	724030	724112	724194	82
530	724276	724358	724440	724522	724603	724685	724767	724849	724931	725013	82
531	725095	725176	725258	725340	725422	725503	725585	725667	725748	725830	82
532	725912	725993	726075	726156	726238	726320	726401	726483	726564	726646	82
533	726727	726809	726890	726972	727053	727134	727216	727297	727379	727460	81
534	727541	727623	727704	727785	727866	727948	728029	728110	728191	728273	81
535	728354	728435	728516	728597	728678	728759	728841	728922	729003	729084	81
536	729165	729246	729327	729408	729489	729570	729651	729732	729813	729893	81
537	729974	730055	730136	730217	730298	730378	730459	730540	730621	730702	81
538	730782	730863	730944	731024	731105	731186	731266	731347	731428	731508	81
539	731589	731669	731750	731830	731911	731991	732072	732152	732233	732313	81
540	732394	732474	732555	732635	732715	732796	732876	732956	733037	733117	80
541	733197	733278	733358	733438	733518	733598	733679	733759	733839	733919	80
542	733999	734079	734159	734240	734320	734400	734480	734560	734640	734720	80
543	734800	734880	734960	735040	735120	735200	735279	735359	735439	735519	80
544	735599	735679	735759	735838	735918	735998	736078	736157	736237	736317	80
545	736396	736476	736556	736635	736715	736795	736874	736954	737034	737113	80
546	737193	737272	737352	737431	737511	737590	737670	737749	737829	737908	79
547	737987	738067	738146	738225	738305	738384	738463	738543	738622	738701	79
548	738781	738860	738939	739018	739097	739177	739256	739335	739414	739493	79
549	739572	739651	739730	739810	739889	739968	740047	740126	740205	740284	79
550	740363	740442	740521	740599	740678	740757	740836	740915	740994	741073	79
551	741152	741230	741309	741388	741467	741546	741624	741703	741782	741860	79
552	741939	742018	742096	742175	742254	742332	742411	742489	742568	742647	79
553	742725	742804	742882	742961	743039	743118	743196	743275	743353	743431	78
554	743510	743588	743667	743745	743823	743902	743980	744058	744136	744215	78
555	744293	744371	744449	744528	744606	744684	744762	744840	744919	744997	78
556	745075	745153	745231	745309	745387	745465	745543	745621	745699	745777	78
557	745855	745933	746011	746089	746167	746245	746323	746401	746479	746556	78
558	746634	746712	746790	746868	746945	747023	747101	747179	747256	747334	78
559	747412	747489	747567	747645	747722	747800	747878	747955	748033	748110	78
560	748188	748266	748343	748421	748498	748576	748653	748731	748808	748885	77
561	748963	749040	749118	749195	749272	749350	749427	749504	749582	749659	77
562	749736	749814	749891	749968	750045	750123	750200	750277	750354	750431	77
563	750508	750586	750663	750740	750817	750894	750971	751048	751125	751202	77
564	751279	751356	751433	751510	751587	751664	751741	751818	751895	751972	77
565	752048	752125	752202	752279	752356	752433	752509	752586	752663	752740	77
566	752816	752893	752970	753047	753123	753200	753277	753353	753430	753506	77
567	753583	753660	753736	753813	753889	753966	754042	754119	754195	754272	77
568	754348	754425	754501	754578	754654	754730	754807	754883	754960	755036	76
569	755112	755189	755265	755341	755417	755494	755570	755646	755722	755799	76
570	755875	755951	756027	756103	756180	756256	756332	756408	756484	756560	76
571	756636	756712	756788	756864	756940	757016	757092	757168	757244	757320	76
572	757396	757472	757548	757624	757700	757775	757851	757927	758003	758079	76
573	758155	758230	758306	758382	758458	758533	758609	758685	758761	758836	76
574	758912	758988	759063	759139	759214	759290	759366	759441	759517	759592	76
575	759668	759743	759819	759894	759970	760045	760121	760196	760272	760347	75
576	760422	760498	760573	760649	760724	760799	760875	760950	761025	761101	75
577	761176	761251	761326	761402	761477	761552	761627	761702	761778	761853	75
578	761928	762003	762078	762153	762228	762303	762378	762453	762529	762604	75
579	762679	762754	762829	762904	762978	763053	763128	763203	763278	763353	75
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 5800——6400 Log. 763428——806180.

No.	0	1	2	3	4	5	6	7	8	9	Diff.
580	763428	763503	763578	763653	763727	763802	763877	763952	764027	764101	75
581	764176	764251	764326	764400	764475	764550	764624	764699	764774	764848	75
582	764923	764998	765072	765147	765221	765296	765370	765445	765520	765594	75
583	765669	765743	765818	765892	765966	766041	766115	766190	766264	766338	74
584	766413	766487	766562	766636	766710	766785	766859	766933	767007	767082	74
585	767156	767230	767304	767379	767453	767527	767601	767675	767749	767823	74
586	767898	767972	768046	768120	768194	768268	768342	768416	768490	768564	74
587	768638	768712	768786	768860	768934	769008	769082	769156	769230	769303	74
588	769377	769451	769525	769599	769673	769746	769820	769894	769968	770042	74
589	770115	770189	770263	770336	770410	770484	770557	770631	770705	770778	74
590	770852	770926	770999	771073	771146	771220	771293	771367	771440	771514	74
591	771587	771661	771734	771808	771881	771955	772028	772102	772175	772248	73
592	772322	772395	772468	772542	772615	772688	772762	772835	772908	772981	73
593	773055	773128	773201	773274	773348	773421	773494	773567	773640	773713	73
594	773786	773860	773933	774006	774079	774152	774225	774298	774371	774444	73
595	774517	774590	774663	774736	774809	774882	774955	775028	775100	775173	73
596	775246	775319	775392	775465	775538	775610	775683	775756	775829	775902	73
597	775974	776047	776120	776193	776265	776338	776411	776483	776556	776629	73
598	776701	776774	776846	776919	776992	777064	777137	777209	777282	777354	73
599	777427	777499	777572	777644	777717	777789	777862	777934	778006	778079	73
600	778151	778224	778296	778368	778441	778513	778585	778658	778730	778802	72
601	778874	778947	779019	779091	779163	779236	779308	779380	779452	779524	72
602	779596	779669	779741	779813	779885	779957	780029	780101	780173	780245	72
603	780317	780389	780461	780533	780605	780677	780749	780821	780893	780965	72
604	781037	781109	781181	781253	781324	781396	781468	781540	781612	781684	72
605	781755	781827	781899	781971	782042	782114	782186	782258	782329	782401	72
606	782473	782544	782616	782688	782759	782831	782902	782974	783046	783117	72
607	783189	783260	783332	783403	783475	783546	783618	783689	783761	783832	71
608	783904	783975	784046	784118	784189	784261	784332	784403	784475	784546	71
609	784617	784689	784760	784831	784902	784974	785045	785116	785187	785259	71
610	785330	785401	785472	785543	785615	785686	785757	785828	785899	785970	71
611	786041	786112	786183	786254	786325	786396	786467	786538	786609	786680	71
612	786751	786822	786893	786964	787035	787106	787177	787248	787319	787390	71
613	787460	787531	787602	787673	787744	787815	787885	787956	788027	788098	71
614	788168	788239	788310	788381	788451	788522	788593	788663	788734	788804	71
615	788875	788946	789016	789087	789157	789228	789299	789369	789440	789510	71
616	789581	789651	789722	789792	789863	789933	790004	790074	790144	790215	70
617	790285	790356	790426	790496	790567	790637	790707	790778	790848	790918	70
618	790988	791059	791129	791199	791269	791340	791410	791480	791550	791620	70
619	791691	791761	791831	791901	791971	792041	792111	792181	792252	792322	70
620	792392	792462	792532	792602	792672	792742	792812	792882	792952	793022	70
621	793092	793162	793231	793301	793371	793441	793511	793581	793651	793721	70
622	793790	793860	793930	794000	794070	794139	794209	794279	794349	794418	70
623	794488	794558	794627	794697	794767	794836	794906	794976	795045	795115	70
624	795185	795254	795324	795393	795463	795532	795602	795671	795741	795811	69
625	795880	795949	796019	796088	796158	796227	796297	796366	796436	796505	69
626	796574	796644	796713	796782	796852	796921	796990	797060	797129	797198	69
627	797268	797337	797406	797475	797545	797614	797683	797752	797821	797890	69
628	797960	798029	798098	798167	798236	798305	798374	798443	798512	798582	69
629	798651	798720	798789	798858	798927	798996	799065	799134	799203	799272	69
630	799341	799409	799478	799547	799616	799685	799754	799823	799892	799961	69
631	800029	800098	800167	800236	800305	800373	800442	800511	800580	800648	69
632	800717	800786	800854	800923	800992	801060	801129	801198	801266	801335	69
633	801404	801472	801541	801609	801678	801747	801815	801884	801952	802021	69
634	802089	802158	802226	802295	802363	802432	802500	802568	802637	802705	68
635	802774	802842	802910	802979	803047	803116	803184	803252	803321	803389	68
636	803457	803525	803594	803662	803730	803798	803867	803935	804003	804071	68
637	804139	804208	804276	804344	804412	804480	804548	804616	804685	804753	68
638	804821	804889	804957	805025	805093	805161	805229	805297	805365	805433	68
639	805501	805569	805637	805705	805773	805841	805908	805976	806044	806112	68
	0	1	2	3	4	5	6	7	8	9	

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TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 6400——7000 Log. 806180——845098

No.	0	1	2	3	4	5	6	7	8	9	Diff.
640	806180	806248	806316	806384	806451	806519	806587	806655	806723	806790	68
641	806858	806926	806994	807061	807129	807197	807264	807332	807400	807467	68
642	807535	807603	807670	807738	807806	807873	807941	808008	808076	808143	68
643	808211	808279	808346	808414	808481	808549	808616	808684	808751	808818	68
644	808886	808953	809021	809088	809156	809223	809290	809358	809425	809492	67
645	809560	809627	809694	809762	809829	809896	809964	810031	810098	810165	67
646	810233	810300	810367	810434	810501	810569	810636	810703	810770	810837	67
647	810904	810971	811038	811106	811173	811240	811307	811374	811441	811508	67
648	811575	811642	811709	811776	811843	811910	811977	812044	812111	812178	67
649	812245	812312	812378	812445	812512	812579	812646	812713	812780	812847	67
650	812913	812980	813047	813114	813181	813247	813314	813381	813448	813514	67
651	813581	813648	813714	813781	813848	813914	813981	814048	814114	814181	67
652	814248	814314	814381	814147	814514	814581	814647	814714	814780	814847	67
653	814913	814980	815046	815113	815179	815246	815312	815378	815445	815511	66
654	815578	815644	815711	815777	815843	815910	815976	816042	816109	816175	66
655	816241	816308	816374	816440	816506	816573	816639	816705	816771	816838	66
656	816904	816970	817036	817102	817169	817235	817301	817367	817433	817499	66
657	817565	817631	817698	817764	817830	817896	817962	818028	818094	818160	66
658	818226	818292	818358	818424	818490	818556	818622	818688	818754	818819	66
659	818885	818951	819017	819083	819149	819215	819281	819346	819412	819478	66
660	819544	819610	819675	819741	819807	819873	819939	820004	820070	820136	66
661	820201	820267	820333	820399	820464	820530	820595	820661	820727	820792	66
662	820858	820924	820989	821055	821120	821186	821251	821317	821382	821448	66
663	821514	821579	821644	821710	821775	821841	821906	821972	822037	822103	65
664	822168	822233	822299	822364	822430	822495	822560	822626	822691	822756	65
665	822822	822887	822952	823018	823083	823148	823213	823279	823344	823409	65
666	823474	823539	823605	823670	823735	823800	823865	823930	823996	824061	65
667	824126	824191	824256	824321	824386	824451	824516	824581	824646	824711	65
668	824776	824841	824906	824971	825036	825101	825166	825231	825296	825361	65
669	825426	825491	825556	825621	825686	825751	825815	825880	825945	826010	65
670	826075	826140	826204	826269	826334	826399	826464	826528	826593	826658	65
671	826723	826787	826852	826917	826981	827046	827111	827175	827240	827305	65
672	827369	827434	827498	827563	827628	827692	827757	827821	827886	827951	65
673	828015	828080	828144	828209	828273	828338	828402	828467	828531	828595	64
674	828660	828724	828789	828853	828918	828982	829046	829111	829175	829239	61
675	829304	829368	829432	829497	829561	829625	829690	829754	829818	829882	64
676	829947	830011	830075	830139	830204	830268	830332	830396	830460	830525	64
677	830589	830653	830717	830781	830845	830909	830973	831037	831102	831166	64
678	831230	831294	831358	831422	831486	831550	831614	831678	831742	831806	64
679	831870	831934	831998	832062	832126	832189	832253	832317	832381	832445	64
680	832509	832573	832637	832700	832764	832828	832892	832956	833020	833083	61
681	833147	833211	833275	833338	833402	833466	833530	833593	833657	833721	64
682	833784	833848	833912	833975	834039	834103	834166	834230	834293	834357	64
683	834421	834484	834548	834611	834675	834739	834802	834866	834929	834993	64
684	835056	835120	835183	835247	835310	835373	835437	835500	835564	835627	63
685	835691	835754	835817	835881	835944	836007	836071	836134	836197	836261	63
686	836324	836387	836451	836514	836577	836641	836704	836767	836830	836894	63
687	836957	837020	837083	837146	837210	837273	837336	837399	837462	837525	63
688	837588	837652	837715	837778	837841	837904	837967	838030	838093	838156	63
689	838219	838282	838345	838408	838471	838534	838597	838660	838723	838786	63
690	838849	838912	838975	839038	839101	839164	839227	839289	839352	839415	63
691	839478	839541	839604	839667	839729	839792	839855	839918	839981	840043	63
692	840106	840169	840232	840294	840357	840420	840482	840545	840608	840671	63
693	840733	840796	840859	840921	840984	841046	841109	841172	841234	841297	63
694	841359	841422	841485	841547	841610	841672	841735	841797	841860	841922	63
695	841985	842047	842110	842172	842235	842297	842360	842422	842484	842547	62
696	842609	842672	842734	842796	842859	842921	842983	843046	843108	843170	62
697	843233	843295	843357	843420	843482	843544	843606	843669	843731	843793	62
698	843855	843918	843980	844042	844104	844166	844229	844291	844353	844415	62
699	844477	844539	844601	844664	844726	844788	844850	844912	844974	845036	62
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 7000———7600 Log. 845098———880814

No.	0	1	2	3	4	5	6	7	8	9	Diff.
700	845098	845160	845222	845284	845346	845408	845470	845532	845594	845656	62
701	845718	845780	845842	845904	845966	846028	846090	846151	846213	846275	62
702	846337	846399	846461	846523	846584	846646	846708	846770	846832	846894	62
703	846955	847017	847079	847141	847202	847264	847326	847388	847449	847511	62
704	847573	847634	847696	847758	847819	847881	847943	848004	848066	848127	62
705	848189	848251	848312	848374	848435	848497	848559	848620	848682	848743	62
706	848805	848866	848928	848989	849051	849112	849174	849235	849296	849358	61
707	849419	849481	849542	849604	849665	849726	849788	849849	849911	849972	61
708	850033	850095	850156	850217	850279	850340	850401	850462	850524	850585	61
709	850646	850707	850769	850830	850891	850952	851014	851075	851136	851197	61
710	851258	851320	851381	851442	851503	851564	851625	851686	851747	851808	61
711	851870	851931	851992	852053	852114	852175	852236	852297	852358	852419	61
712	852480	852541	852602	852663	852724	852785	852846	852907	852968	853029	61
713	853090	853150	853211	853272	853333	853394	853455	853516	853576	853637	61
714	853698	853759	853820	853881	853941	854002	854063	854124	854185	854245	61
715	854306	854367	854427	854488	854549	854610	854670	854731	854792	854852	61
716	854913	854974	855034	855095	855156	855216	855277	855337	855398	855459	61
717	855519	855580	855640	855701	855761	855822	855882	855943	856003	856064	61
718	856124	856185	856245	856306	856366	856427	856487	856548	856608	856668	60
719	856729	856789	856850	856910	856970	857031	857091	857151	857212	857272	60
720	857332	857393	857453	857513	857574	857634	857694	857754	857815	857875	60
721	857935	857995	858056	858116	858176	858236	858297	858357	858417	858477	60
722	858537	858597	858657	858718	858778	858838	858898	858958	859018	859078	60
723	859138	859198	859258	859318	859378	859438	859499	859559	859619	859679	60
724	859739	859799	859858	859918	859978	860038	860098	860158	860218	860278	60
725	860338	860398	860458	860518	860578	860637	860697	860757	860817	860877	60
726	860937	860996	861056	861116	861176	861236	861295	861355	861415	861475	60
727	861534	861594	861654	861714	861773	861833	861893	861952	862012	862072	60
728	862131	862191	862251	862310	862370	862430	862489	862549	862608	862668	60
729	862728	862787	862847	862906	862966	863025	863085	863144	863204	863263	60
730	863323	863382	863442	863501	863561	863620	863680	863739	863798	863858	59
731	863917	863977	864036	864096	864155	864214	864274	864333	864392	864452	59
732	864511	864570	864630	864689	864748	864808	864867	864926	864985	865045	59
733	865104	865163	865222	865282	865341	865400	865459	865518	865578	865637	59
734	865696	865755	865814	865874	865933	865992	866051	866110	866169	866228	59
735	866287	866346	866405	866465	866524	866583	866642	866701	866760	866819	59
736	866878	866937	866996	867055	867114	867173	867232	867291	867350	867409	59
737	867467	867526	867585	867644	867703	867762	867821	867880	867939	867998	59
738	868056	868115	868174	868233	868292	868350	868409	868468	868527	868586	59
739	868644	868703	868762	868821	868879	868938	868997	869056	869114	869173	59
740	869232	869290	869349	869408	869466	869525	869584	869642	869701	869760	59
741	869818	869877	869935	869994	870053	870111	870170	870228	870287	870345	59
742	870404	870462	870521	870579	870638	870696	870755	870813	870872	870930	58
743	870989	871047	871106	871164	871223	871281	871339	871398	871456	871515	58
744	871573	871631	871690	871748	871806	871865	871923	871981	872040	872098	58
745	872156	872215	872273	872331	872389	872448	872506	872564	872622	872681	58
746	872739	872797	872855	872913	872972	873030	873088	873146	873204	873262	58
747	873321	873379	873437	873495	873553	873611	873669	873727	873785	873844	58
748	873902	873960	874018	874076	874134	874192	874250	874308	874366	874424	58
749	874482	874540	874598	874656	874714	874772	874830	874887	874945	875003	58
750	875061	875119	875177	875235	875293	875351	875409	875466	875524	875582	58
751	875640	875698	875756	875813	875871	875929	875987	876045	876102	876160	58
752	876218	876276	876333	876391	876449	876507	876564	876622	876680	876737	58
753	876795	876853	876910	876968	877026	877083	877141	877198	877256	877314	58
754	877371	877429	877486	877544	877602	877659	877717	877774	877832	877889	58
755	877947	878004	878062	878119	878177	878234	878292	878349	878407	878464	57
756	878522	878579	878637	878694	878751	878809	878866	878924	878981	879038	57
757	879096	879153	879211	879268	879325	879383	879440	879497	879555	879612	57
758	879669	879726	879784	879841	879898	879956	880013	880070	880127	880185	57
759	880242	880299	880356	880413	880471	880528	880585	880642	880699	880756	57
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 7600———8200 Log. 880814———913814

No.	0	1	2	3	4	5	6	7	8	9	Diff.
760	880814	880871	880928	880985	881042	881099	881156	881213	881270	881328	57
761	881385	881442	881499	881556	881613	881670	881727	881784	881841	881898	57
762	881955	882012	882069	882126	882183	882240	882297	882354	882411	882468	57
763	882524	882581	882638	882695	882752	882809	882866	882923	882980	883037	57
764	883093	883150	883207	883264	883321	883377	883434	883491	883548	883605	57
765	883661	883718	883775	883832	883888	883945	884002	884059	884115	884172	57
766	884229	884285	884342	884399	884455	884512	884569	884625	884682	884739	57
767	884795	884852	884909	884965	885022	885078	885135	885192	885248	885305	57
768	885361	885418	885474	885531	885587	885644	885700	885757	885813	885870	57
769	885926	885983	886039	886096	886152	886209	886265	886321	886378	886434	56
770	886491	886547	886604	886660	886716	886773	886829	886885	886942	886998	56
771	887054	887111	887167	887223	887280	887336	887392	887449	887505	887561	56
772	887617	887674	887730	887786	887842	887898	887955	888011	888067	888123	56
773	888179	888236	888292	888348	888404	888460	888516	888573	888629	888685	56
774	888741	888797	888853	888909	888965	889021	889077	889134	889190	889246	56
775	889302	889358	889414	889470	889526	889582	889638	889694	889750	889806	56
776	889862	889918	889974	890030	890086	890141	890197	890253	890309	890365	56
777	890421	890477	890533	890589	890644	890700	890756	890812	890868	890924	56
778	890980	891035	891091	891147	891203	891259	891314	891370	891426	891482	56
779	891537	891593	891649	891705	891760	891816	891872	891928	891983	892039	56
780	892095	892150	892206	892262	892317	892373	892429	892484	892540	892595	56
781	892651	892707	892762	892818	892873	892929	892985	893040	893096	893151	56
782	893207	893262	893318	893373	893429	893484	893540	893595	893651	893706	56
783	893762	893817	893873	893928	893984	894039	894094	894150	894205	894261	55
784	894316	894371	894427	894482	894538	894593	894648	894704	894759	894814	55
785	894870	894925	894980	895036	895091	895146	895201	895257	895312	895367	55
786	895423	895478	895533	895588	895643	895699	895754	895809	895864	895920	55
787	895975	896030	896085	896140	896195	896251	896306	896361	896416	896471	55
788	896526	896581	896636	896692	896747	896802	896857	896912	896967	897022	55
789	897077	897132	897187	897242	897297	897352	897407	897462	897517	897572	55
790	897627	897682	897737	897792	897847	897902	897957	898012	898067	898122	55
791	898176	898231	898286	898341	898396	898451	898506	898561	898615	898670	55
792	898725	898780	898835	898890	898944	898999	899054	899109	899164	899218	55
793	899273	899328	899383	899437	899492	899547	899602	899656	899711	899766	55
794	899820	899875	899930	899985	900039	900094	900149	900203	900258	900312	55
795	900367	900422	900476	900531	900586	900640	900695	900749	900804	900858	55
796	900913	900968	901022	901077	901131	901186	901240	901295	901349	901404	55
797	901458	901513	901567	901622	901676	901731	901785	901840	901894	901948	54
798	902003	902057	902112	902166	902221	902275	902329	902384	902438	902491	54
799	902547	902601	902655	902710	902764	902818	902873	902927	902981	903036	54
800	903090	903144	903198	903253	903307	903361	903416	903470	903524	903578	54
801	903632	903687	903741	903795	903849	903903	903958	904012	904066	904120	54
802	904174	904228	904283	904337	904391	904445	904499	904553	904607	904661	54
803	904715	904770	904824	904878	904932	904986	905040	905094	905148	905202	54
804	905256	905310	905364	905418	905472	905526	905580	905634	905688	905742	54
805	905796	905850	905904	905958	906012	906065	906119	906173	906227	906281	54
806	906335	906389	906443	906497	906550	906604	906658	906712	906766	906820	54
807	906873	906927	906981	907035	907089	907142	907196	907250	907304	907358	54
808	907411	907465	907519	907573	907626	907680	907734	907787	907841	907895	54
809	907948	908002	908056	908109	908163	908217	908270	908324	908378	908431	54
810	908485	908539	908592	908646	908699	908753	908807	908860	908914	908967	54
811	909021	909074	909128	909181	909235	909288	909342	909395	909449	909502	54
812	909556	909609	909663	909716	909770	909823	909877	909930	909984	910037	53
813	910090	910144	910197	910251	910304	910358	910411	910464	910518	910571	53
814	910624	910678	910731	910784	910838	910891	910944	910998	911051	911104	53
815	911158	911211	911264	911317	911371	911424	911477	911530	911584	911637	53
816	911690	911743	911797	911850	911903	911956	912009	912063	912116	912169	53
817	912222	912275	912328	912381	912435	912488	912541	912594	912647	912700	53
818	912753	912806	912859	912913	912966	913019	913072	913125	913178	913231	53
819	913284	913337	913390	913443	913496	913549	913602	913655	913708	913761	53
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 8200——8800 Log. 913814——944483

No.	0	1	2	3	4	5	6	7	8	9	Diff.
820	913814	913867	913920	913973	914026	914079	914131	914184	914237	914290	53
821	914343	914396	914449	914502	914555	914608	914660	914713	914766	914819	53
822	914872	914925	914977	915030	915083	915136	915189	915241	915294	915347	53
823	915400	915453	915505	915558	915611	915664	915716	915769	915822	915874	53
824	915927	915980	916033	916085	916138	916191	916243	916296	916349	916401	53
825	916454	916507	916559	916612	916664	916717	916770	916822	916875	916927	53
826	916980	917033	917085	917138	917190	917243	917295	917348	917400	917453	53
827	917505	917558	917610	917663	917715	917768	917820	917873	917925	917978	52
828	918030	918083	918135	918188	918240	918292	918345	918397	918450	918502	52
829	918555	918607	918659	918712	918764	918816	918869	918921	918973	919026	52
830	919078	919130	919183	919235	919287	919340	919392	919444	919496	919549	52
831	919601	919653	919705	919758	919810	919862	919914	919967	920019	920071	52
832	920123	920175	920228	920280	920332	920384	920436	920489	920541	920593	52
833	920645	920697	920749	920801	920853	920906	920958	921010	921062	921114	52
834	921166	921218	921270	921322	921374	921426	921478	921530	921582	921634	52
835	921686	921738	921790	921842	921894	921946	921998	922050	922102	922154	52
836	922206	922258	922310	922362	922414	922466	922518	922570	922622	922674	52
837	922725	922777	922829	922881	922933	922985	923037	923088	923140	923192	52
838	923244	923296	923348	923399	923451	923503	923555	923607	923658	923710	52
839	923762	923814	923865	923917	923969	924021	924072	924124	924176	924228	52
840	924279	924331	924383	924434	924486	924538	924589	924641	924693	924744	52
841	924796	924848	924899	924951	925002	925054	925106	925157	925209	925260	52
842	925312	925364	925415	925467	925518	925570	925621	925673	925724	925776	52
843	925828	925879	925931	925982	926034	926085	926137	926188	926239	926291	51
844	926342	926394	926445	926497	926548	926600	926651	926702	926754	926805	51
845	926857	926908	926959	927011	927062	927114	927165	927216	927268	927319	51
846	927370	927422	927473	927524	927576	927627	927678	927730	927781	927832	51
847	927883	927935	927986	928037	928088	928140	928191	928242	928293	928345	51
848	928396	928447	928498	928549	928601	928652	928703	928754	928805	928856	51
849	928908	928959	929010	929061	929112	929163	929214	929266	929317	929368	51
850	929419	929470	929521	929572	929623	929674	929725	929776	929827	929878	51
851	929930	929981	930032	930083	930134	930185	930236	930287	930338	930389	51
852	930440	930491	930541	930592	930643	930694	930745	930796	930847	930898	51
853	930949	931000	931051	931102	931153	931203	931254	931305	931356	931407	51
854	931458	931509	931560	931610	931661	931712	931763	931814	931864	931915	51
855	931966	932017	932068	932118	932169	932220	932271	932321	932372	932423	51
856	932474	932524	932575	932626	932677	932727	932778	932829	932879	932930	51
857	932981	933031	933082	933133	933183	933234	933285	933335	933386	933437	51
858	933487	933538	933588	933639	933690	933740	933791	933841	933892	933943	51
859	933993	934044	934094	934145	934195	934246	934296	934347	934397	934448	51
860	934498	934549	934599	934650	934700	934751	934801	934852	934902	934953	50
861	935003	935054	935104	935154	935205	935255	935306	935356	935406	935457	50
862	935507	935558	935608	935658	935709	935759	935809	935860	935910	935960	50
863	936011	936061	936111	936162	936212	936262	936313	936363	936413	936463	50
864	936514	936564	936614	936664	936715	936765	936815	936865	936916	936966	50
865	937016	937066	937116	937167	937217	937267	937317	937367	937418	937468	50
866	937518	937568	937618	937668	937718	937769	937819	937869	937919	937969	50
867	938019	938069	938119	938169	938219	938269	938319	938370	938420	938470	50
868	938520	938570	938620	938670	938720	938770	938820	938870	938920	938970	50
869	939020	939070	939120	939170	939220	939270	939319	939369	939419	939469	50
870	939519	939569	939619	939669	939719	939769	939819	939868	939918	939968	50
871	940018	940068	940118	940168	940218	940267	940317	940367	940417	940467	50
872	940516	940566	940616	940666	940716	940765	940815	940865	940915	940964	50
873	941014	941064	941114	941163	941213	941263	941313	941362	941412	941462	50
874	941511	941561	941611	941660	941710	941760	941809	941859	941909	941958	50
875	942008	942058	942107	942157	942206	942256	942306	942355	942405	942454	50
876	942504	942554	942603	942653	942702	942752	942801	942851	942900	942950	50
877	943000	943049	943099	943148	943198	943247	943297	943346	943396	943445	49
878	943494	943544	943593	943643	943692	943742	943791	943841	943890	943939	49
879	943989	944038	944088	944137	944186	944236	944285	944335	944384	944433	49
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 8800———9400 Log. 944483———973128.

No.	0	1	2	3	4	5	6	7	8	9	Diff.
880	944483	944532	944581	944631	944680	944729	944779	944828	944877	944927	49
881	944976	945025	945074	945124	945173	945222	945272	945321	945370	945419	49
882	945469	945518	945567	945610	945665	945715	945764	945813	945862	945911	49
883	945961	946010	946059	946108	946157	946207	946256	946305	946354	946403	49
884	946452	946501	946550	946600	946649	946698	946747	946796	946845	946894	49
885	946943	946992	947041	947090	947139	947189	947238	947287	947336	947385	49
886	947434	947483	947532	947581	947630	947679	947728	947777	947826	947875	49
887	947924	947973	948021	948070	948119	948168	948217	948266	948315	948364	49
888	948413	948462	948511	948560	948608	948657	948706	948755	948804	948853	49
889	948902	948951	948999	949048	949097	949146	949195	949244	949292	949341	49
890	949390	949439	949488	949536	949585	949634	949683	949731	949780	949829	49
891	949878	949926	949975	950024	950073	950121	950170	950219	950267	950316	49
892	950365	950413	950462	950511	950560	950608	950657	950705	950754	950803	49
893	950851	950900	950949	950997	951046	951095	951143	951192	951240	951289	49
894	951337	951386	951435	951483	951532	951580	951629	951677	951726	951774	49
895	951823	951872	951920	951969	952017	952066	952114	952163	952211	952259	48
896	952308	952356	952405	952453	952502	952550	952599	952647	952696	952744	48
897	952792	952841	952889	952938	952986	953034	953083	953131	953180	953228	48
898	953276	953325	953373	953421	953470	953518	953566	953615	953663	953711	48
899	953760	953808	953856	953905	953953	954001	954049	954098	954146	954194	48
900	954242	954291	954339	954387	954435	954484	954532	954580	954628	954677	48
901	954725	954773	954821	954869	954918	954966	955014	955062	955110	955158	48
902	955206	955255	955303	955351	955399	955447	955495	955543	955592	955640	48
903	955688	955736	955784	955832	955880	955928	955976	956024	956072	956120	48
904	956168	956216	956264	956312	956361	956409	956457	956505	956553	956601	48
905	956649	956697	956745	956792	956840	956888	956936	956984	957032	957080	48
906	957128	957176	957224	957272	957320	957368	957416	957464	957511	957559	48
907	957607	957655	957703	957751	957799	957847	957894	957942	957990	958038	48
908	958086	958134	958181	958229	958277	958325	958373	958420	958468	958516	48
909	958564	958612	958659	958707	958755	958803	958850	958898	958946	958994	48
910	959041	959089	959137	959184	959232	959280	959328	959375	959423	959471	48
911	959518	959566	959614	959661	959709	959757	959804	959852	959900	959947	48
912	959995	960042	960090	960138	960185	960233	960281	960328	960376	960423	48
913	960471	960518	960566	960613	960661	960709	960756	960804	960851	960899	48
914	960946	960994	961041	961089	961136	961184	961231	961279	961326	961374	48
915	961421	961469	961516	961563	961611	961658	961706	961753	961801	961848	47
916	961895	961943	961990	962038	962085	962132	962180	962227	962275	962322	47
917	962369	962417	962464	962511	962559	962606	962653	962701	962748	962795	47
918	962843	962890	962937	962985	963032	963079	963126	963174	963221	963268	47
919	963315	963363	963410	963457	963504	963552	963599	963646	963693	963741	47
920	963788	963835	963882	963929	963977	964024	964071	964118	964165	964212	47
921	964260	964307	964354	964401	964448	964495	964542	964590	964637	964684	47
922	964731	964778	964825	964872	964919	964966	965013	965060	965108	965155	47
923	965202	965249	965296	965343	965390	965437	965484	965531	965578	965625	47
924	965672	965719	965766	965813	965860	965907	965954	966001	966048	966095	47
925	966142	966189	966236	966283	966329	966376	966423	966470	966517	966564	47
926	966611	966658	966705	966752	966798	966845	966892	966939	966986	967033	47
927	967080	967127	967173	967220	967267	967314	967361	967408	967454	967501	47
928	967548	967595	967642	967688	967735	967782	967829	967875	967922	967969	47
929	968016	968062	968109	968156	968203	968249	968296	968343	968389	968436	47
930	968483	968530	968576	968623	968670	968716	968763	968810	968856	968903	47
931	968950	968996	969043	969090	969136	969183	969229	969276	969323	969369	47
932	969416	969462	969509	969556	969602	969649	969695	969742	969788	969835	47
933	969882	969928	969975	970021	970068	970114	970161	970207	970254	970300	47
934	970347	970393	970440	970486	970533	970579	970626	970672	970719	970765	47
935	970812	970858	970904	970951	970997	971044	971090	971137	971183	971229	46
936	971276	971322	971369	971415	971461	971508	971554	971600	971647	971693	46
937	971740	971786	971832	971879	971925	971971	972018	972064	972110	972156	46
938	972203	972249	972295	972342	972388	972434	972480	972527	972573	972619	46
939	972666	972712	972758	972804	972851	972897	972943	972989	973035	973082	46
	0	1	2	3	4	5	6	7	8	9	

TABLE XXIV.

LOGARITHMS OF NUMBERS.

No. 9400——10000 Log. 973128——000000

No.	0	1	2	3	4	5	6	7	8	9	Diff.
940	973128	973174	973220	973266	973313	973359	973405	973451	973497	973543	46
941	973590	973636	973682	973728	973774	973820	973866	973913	973959	974005	46
942	974051	974097	974143	974189	974235	974281	974327	974373	974420	974466	46
943	974512	974558	974604	974650	974696	974742	974788	974834	974880	974926	46
944	974972	975018	975064	975110	975156	975202	975248	975294	975340	975386	46
945	975432	975478	975524	975570	975616	975661	975707	975753	975799	975845	46
946	975891	975937	975983	976029	976075	976121	976166	976212	976258	976304	46
947	976350	976396	976442	976487	976533	976579	976625	976671	976717	976762	46
948	976808	976854	976900	976946	976991	977037	977083	977129	977175	977220	46
949	977266	977312	977358	977403	977449	977495	977541	977586	977632	977678	46
950	977724	977769	977815	977861	977906	977952	977998	978043	978089	978135	46
951	978180	978226	978272	978317	978363	978409	978454	978500	978546	978591	46
952	978637	978683	978728	978774	978819	978865	978911	978956	979002	979047	46
953	979093	979138	979184	979230	979275	979321	979366	979412	979457	979503	46
954	979548	979594	979639	979685	979730	979776	979821	979867	979912	979958	46
955	980003	980049	980094	980140	980185	980231	980276	980322	980367	980412	45
956	980458	980503	980549	980594	980640	980685	980730	980776	980821	980867	45
957	980912	980957	981003	981048	981093	981139	981184	981229	981275	981320	45
958	981365	981411	981456	981501	981547	981592	981637	981683	981728	981773	45
959	981819	981864	981909	981954	982000	982045	982090	982135	982181	982226	45
960	982271	982316	982362	982407	982452	982497	982543	982588	982633	982678	45
961	982723	982769	982814	982859	982904	982949	982994	983040	983085	983130	45
962	983175	983220	983265	983310	983356	983401	983446	983491	983536	983581	45
963	983626	983671	983716	983762	983807	983852	983897	983942	983987	984032	45
964	984077	984122	984167	984212	984257	984302	984347	984392	984437	984482	45
965	984527	984572	984617	984662	984707	984752	984797	984842	984887	984932	45
966	984977	985022	985067	985112	985157	985202	985247	985292	985337	985382	45
967	985426	985471	985516	985561	985606	985651	985696	985741	985786	985830	45
968	985875	985920	985965	986010	986055	986100	986144	986189	986234	986279	45
969	986324	986369	986413	986458	986503	986548	986593	986637	986682	986727	45
970	986772	986816	986861	986906	986951	986995	987040	987085	987130	987174	45
971	987219	987264	987309	987353	987398	987443	987487	987532	987577	987622	45
972	987666	987711	987756	987800	987845	987890	987934	987979	988024	988068	45
973	988113	988157	988202	988247	988291	988336	988381	988425	988470	988514	45
974	988559	988603	988648	988693	988737	988782	988826	988871	988915	988960	45
975	989005	989049	989094	989138	989183	989227	989272	989316	989361	989405	45
976	989450	989494	989539	989583	989628	989672	989717	989761	989806	989850	44
977	989895	989939	989983	990028	990072	990117	990161	990206	990250	990294	44
978	990339	990383	990428	990472	990516	990561	990605	990650	990694	990738	44
979	990783	990827	990871	990916	990960	991004	991049	991093	991137	991182	44
980	991226	991270	991315	991359	991403	991448	991492	991536	991580	991625	44
981	991669	991713	991757	991802	991846	991890	991934	991979	992023	992067	44
982	992111	992156	992200	992244	992288	992333	992377	992421	992465	992509	44
983	992553	992598	992642	992686	992730	992774	992818	992863	992907	992951	44
984	992995	993039	993083	993127	993172	993216	993260	993304	993348	993392	44
985	993436	993480	993524	993568	993613	993657	993701	993745	993789	993833	44
986	993877	993921	993965	994009	994053	994097	994141	994185	994229	994273	44
987	994317	994361	994405	994449	994493	994537	994581	994625	994669	994713	44
988	994757	994801	994845	994889	994933	994977	995021	995064	995108	995152	44
989	995196	995240	995284	995328	995372	995416	995460	995504	995547	995591	44
990	995635	995679	995723	995767	995811	995854	995898	995942	995986	996030	44
991	996074	996117	996161	996205	996249	996293	996336	996380	996424	996468	44
992	996512	996555	996599	996643	996687	996730	996774	996818	996862	996905	44
993	996949	996993	997037	997080	997124	997168	997212	997255	997299	997343	44
994	997386	997430	997474	997517	997561	997605	997648	997692	997736	997779	44
995	997823	997867	997910	997954	997998	998041	998085	998128	998172	998216	44
996	998259	998303	998346	998390	998434	998477	998521	998564	998608	998652	44
997	998695	998739	998782	998826	998869	998913	998956	999000	999043	999087	44
998	999130	999174	999218	999261	999305	999348	999392	999435	999478	999522	44
999	999565	999609	999652	999696	999739	999783	999826	999870	999913	999957	43
		1	2	3	4	5	6	7	8	9	

TABLE XXV.

LOGARITHMIC SINES AND TANGENTS.

0 Degree.

M	S	Sine.	Diff.	Tang.	S	M
0	0					60
	10	5.685575	301030	5.685575	50	
	20	5.986605	176091	5.986605	40	
	30	6.162696	124939	6.162696	30	
	40	6.287635	96910	6.287635	20	
	50	6.384545	79181	6.384545	10	
1		6.463726	66947	6.463726		59
	10	6.530673	57992	6.530673	50	
	20	6.588665	51152	6.588665	40	
	30	6.639817	45758	6.639817	30	
	40	6.685575	41393	6.685575	20	
	50	6.726967	37789	6.726967	10	
2		6.764756	34762	6.764756		58
	10	6.799518	32185	6.799518	50	
	20	6.831703	29963	6.831703	40	
	30	6.861666	28029	6.861666	30	
	40	6.889695	26329	6.889695	20	
	50	6.916024	24823	6.916024	10	
3		6.940847	23481	6.940847		57
	10	6.964328	22276	6.964329	50	
	20	6.986605	21189	6.986605	40	
	30	7.007794	20203	7.007794	30	
	40	7.027997	19305	7.027998	20	
	50	7.047303	18483	7.047303	10	
4		7.065786	17729	7.065786		56
	10	7.083515	17033	7.083515	50	
	20	7.100548	16390	7.100548	40	
	30	7.116938	15795	7.116939	30	
	40	7.132733	15240	7.132733	20	
	50	7.147973	14723	7.147973	10	
5		7.162696	14240	7.162696		55
	10	7.176936	13788	7.176937	50	
	20	7.190725	13361	7.190725	40	
	30	7.204089	12965	7.204089	30	
	40	7.217054	12589	7.217054	20	
	50	7.229643	12234	7.229643	10	
6		7.241877	11899	7.241878		54
	10	7.253776	11582	7.253777	50	
	20	7.265358	11281	7.265359	40	
	30	7.276639	10995	7.276640	30	
	40	7.287635	10724	7.287635	20	
	50	7.298358	10466	7.298359	10	
7		7.308824	10219	7.308825		53
	10	7.319043	9984	7.319044	50	
	20	7.329027	9760	7.329028	40	
	30	7.338787	9545	7.338788	30	
	40	7.348332	9340	7.348333	20	
	50	7.357672	9144	7.357673	10	
8		7.366816	8955	7.366817		52
	10	7.375770	8774	7.375772	50	
	20	7.384544	8600	7.384546	40	
	30	7.393145	8433	7.393146	30	
	40	7.401578	8273	7.401579	20	
	50	7.409850	8118	7.409852	10	
9		7.417968	7969	7.417970		51
	10	7.425937	7825	7 425939	50	
	20	7.433762	7687	7.433764	40	
	30	7.441449	7553	7.441451	30	
	40	7.449002	7424	7.449004	20	
	50	7.456126	7299	7.456128	10	
10		7.463725		7.463727		50
M	S	Co-sine.	Diff.	Co-tan.	S	M

89 Degrees.

0 Degree.

M	S	Sine.	Diff.	Tang.	S	M
10		7.463725	7179	7.463727		50
	10	7.470904	7062	7.470906	50	
	20	7.477966	6949	7.477968	40	
	30	7.484915	6839	7.484917	30	
	40	7.491754	6733	7.491756	20	
	50	7.498487	6631	7.498490	10	
11		7.505118	6531	7.505120		49
	10	7.511649	6434	7.511651	50	
	20	7.518083	6340	7.518085	40	
	30	7.524423	6249	7.524426	30	
	40	7.530672	6160	7.530675	20	
	50	7.536832	6074	7.536835	10	
12		7.542906	5990	7.542909		48
	10	7.548897	5909	7.548899	50	
	20	7.554806	5829	7.554808	40	
	30	7.560635	5752	7.560638	30	
	40	7.566387	5678	7.566390	20	
	50	7.572065	5603	7.572068	10	
13		7.577668	5533	7.577671		47
	10	7.583201	5463	7.583204	50	
	20	7.588664	5395	7.588667	40	
	30	7.594059	5329	7.594062	30	
	40	7.599388	5264	7.599391	20	
	50	7.604652	5201	7.604655	10	
14		7.609853	5140	7.609857		46
	10	7.614993	5079	7.614996	50	
	20	7.620072	5021	7.620076	40	
	30	7.625093	4963	7.625097	30	
	40	7.630056	4907	7.630060	20	
	50	7.634963	4852	7.634968	10	
15		7.639816	4799	7.639820		45
	10	7.644615	4746	7.644619	50	
	20	7.649361	4695	7.649366	40	
	30	7.654056	4645	7.654061	30	
	40	7.658701	4596	7.658706	20	
	50	7.663297	4548	7.663301	10	
16		7.667844	4501	7.667849		44
	10	7.672345	4454	7.672350	50	
	20	7.676799	4409	7.676804	40	
	30	7.681208	4365	7.681213	30	
	40	7.685573	4321	7.685578	20	
	50	7.689894	4279	7.689900	10	
17		7.694173	4237	7.694179		43
	10	7.698410	4196	7.698416	50	
	20	7.702606	4156	7.702612	40	
	30	7.706762	4117	7.706768	30	
	40	7.710879	4078	7.710885	20	
	50	7.714957	4040	7.714962	10	
18		7.718997	4002	7.719003		42
	10	7.722999	3966	7.723005	50	
	20	7.726965	3930	7.726972	40	
	30	7.730896	3895	7.730902	30	
	40	7.734791	3860	7.734797	20	
	50	7.738651	3826	7.738658	10	
19		7.742477	3793	7.742484		41
	10	7.746270	3760	7.746277	50	
	20	7.750031	3728	7.750037	40	
	30	7.753758	3696	7.753765	30	
	40	7.757454	3665	7.757462	20	
	50	7.761119	3634	7.761127	10	
20		7.764754		7.764761		40
M	S	Co-sine.	Diff.	Co-tan.	S	M

89 Degrees.

TABLE XXV.

LOGARITHMIC SINES AND TANGENTS.

0 Degree.							0 Degree.						
M	S	Sine.	Diff.	Tang.	S	M	M	S	Sine.	Diff.	Tang.	S	M
20	0	7.764754		7.764761		40	30		7.940842		7.940858		30
	10	7.768358	3604	7.768365	50			10	7.943248	2406	7.943265	50	
	20	7.771932	3575	7.771940	40			20	7.945641	2393	7.945658	40	
	30	7.775477	3545	7.775485	30			30	7.948020	2379	7.948037	30	
	40	7.778994	3517	7.779002	20			40	7.950387	2367	7.950404	20	
	50	7.782482	3488	7.782490	10			50	7.952741	2354	7.952758	10	
21		7.785943	3461	7.785951		39	31		7.955082	2341	7.955100		29
	10	7.789376	3433	7.789384	50			10	7.957411	2329	7.957428	50	
	20	7.792782	3406	7.792790	40			20	7.959727	2316	7.959745	40	
	30	7.796162	3380	7.796170	30			30	7.962031	2304	7.962049	30	
	40	7.799515	3354	7.799524	20			40	7.964322	2292	7.964341	20	
	50	7.802843	3328	7.802852	10			50	7.966602	2280	7.966621	10	
22		7.806146	3303	7.806155		38	32		7.968870	2268	7.968889		28
	10	7.809424	3278	7.809433	50			10	7.971126	2256	7.971145	50	
	20	7.812677	3253	7.812686	40			20	7.973370	2244	7.973389	40	
	30	7.815906	3229	7.815915	30			30	7.975603	2233	7.975622	30	
	40	7.819111	3205	7.819120	20			40	7.977824	2221	7.977844	20	
	50	7.822292	3182	7.822302	10			50	7.980034	2210	7.980054	10	
23		7.825451	3158	7.825460		37	33		7.982233	2199	7.982253		27
	10	7.828586	3136	7.828596	50			10	7.984421	2188	7.984441	50	
	20	7.831700	3114	7.831710	40			20	7.986598	2177	7.986619	40	
	30	7.834791	3091	7.834801	30			30	7.988764	2166	7.988785	30	
	40	7.837860	3069	7.837870	20			40	7.990919	2155	7.990940	20	
	50	7.840907	3048	7.840918	10			50	7.993064	2145	7.993085	10	
24		7.843934	3026	7.843944		36	34		7.995198	2134	7.995219		26
	10	7.846939	3006	7.846950	50			10	7.997322	2124	7.997343	50	
	20	7.849924	2985	7.849935	40			20	7.999435	2113	7.999457	40	
	30	7.852889	2965	7.852900	30			30	8.001538	2103	8.001560	30	
	40	7.855833	2944	7.855844	20			40	8.003631	2093	8.003653	20	
	50	7.858757	2924	7.858769	10			50	8.005714	2083	8.005736	10	
25		7.861662	2905	7.861674		35	35		8.007787	2073	8.007809		25
	10	7.864548	2886	7.864560	50			10	8.009850	2063	8.009872	50	
	20	7.867415	2867	7.867426	40			20	8.011903	2053	8.011926	40	
	30	7.870262	2848	7.870274	30			30	8.013947	2044	8.013970	30	
	40	7.873092	2830	7.873104	20			40	8.015981	2034	8.016004	20	
	50	7.875903	2811	7.875915	10			50	8.018006	2025	8.018029	10	
26		7.878695	2793	7.878708		34	36		8.020021	2015	8.020045		24
	10	7.881470	2775	7.881483	50			10	8.022027	2006	8.022051	50	
	20	7.884228	2757	7.884240	40			20	8.024023	1997	8.024048	40	
	30	7.886968	2740	7.886981	30			30	8.026011	1988	8.026035	30	
	40	7.889691	2723	7.889704	20			40	8.027989	1978	8.028014	20	
	50	7.892396	2706	7.892410	10			50	8.029959	1970	8.029984	10	
27		7.895085	2689	7.895099		33	37		8.031920	1961	8.031945		23
	10	7.897758	2673	7.897772	50			10	8.033871	1952	8.033897	50	
	20	7.900414	2656	7.900428	40			20	8.035814	1943	8.035840	40	
	30	7.903054	2640	7.903068	30			30	8.037749	1935	8.037775	30	
	40	7.905678	2624	7.905692	20			40	8.039675	1926	8.039701	20	
	50	7.908287	2609	7.908301	10			50	8.041592	1917	8.041618	10	
28		7.910879	2593	7.910894		32	38		8.043501	1909	8.043527		22
	10	7.913457	2577	7.913471	50			10	8.045401	1900	8.045428	50	
	20	7.916019	2562	7.916034	40			20	8.047294	1893	8.047321	40	
	30	7.918566	2547	7.918581	30			30	8.049178	1884	8.049205	30	
	40	7.921098	2532	7.921113	20			40	8.051054	1876	8.051081	20	
	50	7.923616	2518	7.923631	10			50	8.052922	1868	8.052949	10	
29		7.926119	2503	7.926134		31	39		8.054781	1860	8.054809		21
	10	7.928608	2489	7.928623	50			10	8.056633	1852	8.056661	50	
	20	7.931082	2475	7.931098	40			20	8.058477	1844	8.058506	40	
	30	7.933543	2461	7.933559	30			30	8.060314	1836	8.060342	30	
	40	7.935990	2447	7.936006	20			40	8.062142	1828	8.062171	20	
	50	7.938422	2433	7.938439	10			50	8.063963	1821	8.063992	10	
30		7.940842	2420	7.940858		30	40		8.065776	1813	8.065806		20
M	S	Co-sine.	Diff.	Co-tan.	S	M	M	S	Co-sine.	Diff.	Co-tan.	S	M
89 Degrees.							89 Degrees.						

TABLE XXV.

LOGARITHMIC SINES AND TANGENTS.

0 Degree.

M	S	Sine.	Diff.	Tang.	S	M
40	0	8.065776	1806	8.065806		20
	10	8.067582	1798	8.067612	50	
	20	8.069380	1791	8.069410	40	
	30	8.071171	1784	8.071201	30	
	40	8.072955	1776	8.072985	20	
	50	8.074731	1769	8.074761	10	
41		8.076500	1761	8.076531		19
	10	8.078261	1755	8.078293	50	
	20	8.080016	1748	8.080048	40	
	30	8.081764	1740	8.081795	30	
	40	8.083504	1734	8.083536	20	
	50	8.085238	1727	8.085270	10	
42		8.086965	1720	8.086997		18
	10	8.088685	1713	8.088717	50	
	20	8.090398	1706	8.090430	40	
	30	8.092104	1700	8.092137	30	
	40	8.093804	1693	8.093837	20	
	50	8.095497	1686	8.095530	10	
43		8.097183	1680	8.097217		17
	10	8.098863	1674	8.098897	50	
	20	8.100537	1667	8.100571	40	
	30	8.102204	1660	8.102239	30	
	40	8.103864	1654	8.103899	20	
	50	8.105519	1648	8.105554	10	
44		8.107167	1642	8.107202		16
	10	8.108809	1636	8.108845	50	
	20	8.110445	1629	8.110481	40	
	30	8.112074	1623	8.112110	30	
	40	8.113697	1618	8.113734	20	
	50	8.115315	1611	8.115352	10	
45		8.116926	1606	8.116963		15
	10	8.118532	1599	8.118569	50	
	20	8.120131	1594	8.120169	40	
	30	8.121725	1588	8.121763	30	
	40	8.123313	1582	8.123351	20	
	50	8.124895	1576	8.124933	10	
46		8.126471	1571	8.126510		14
	10	8.128042	1565	8.128081	50	
	20	8.129607	1559	8.129646	40	
	30	8.131166	1554	8.131206	30	
	40	8.132720	1548	8.132760	20	
	50	8.134268	1542	8.134308	10	
47		8.135810	1538	8.135851		13
	10	8.137348	1532	8.137389	50	
	20	8.138880	1526	8.138921	40	
	30	8.140406	1521	8.140447	30	
	40	8.141927	1516	8.141969	20	
	50	8.143443	1510	8.143485	10	
48		8.144953	1506	8.144996		12
	10	8.146459	1501	8.146501	50	
	20	8.147959	1494	8.148002	40	
	30	8.149453	1490	8.149497	30	
	40	8.150943	1485	8.150987	20	
	50	8.152428	1479	8.152472	10	
49		8.153907	1475	8.153952		11
	10	8.155382	1470	8.155426	50	
	20	8.156852	1465	8.156896	40	
	30	8.158316	1460	8.158361	30	
	40	8.159776	1455	8.159821	20	
	50	8.161231	1450	8.161276	10	
50		8.162681		8.162727		10
M	S	Co-sine.	Diff.	Co tan.	S	M

89 Degrees.

0 Degree.

M	S	Sine.	Diff.	Tang.	S	M
50	0	8.162681	1445	8.162727		10
	10	8.164126	1440	8.164172	50	
	20	8.165566	1436	8.165613	40	
	30	8.167002	1431	8.167049	30	
	40	8.168433	1426	8.168480	20	
	50	8.169859	1421	8.169906	10	
51		8.171280	1417	8.171328		9
	10	8.172697	1412	8.172745	50	
	20	8.174109	1408	8.174158	40	
	30	8.175517	1403	8.175566	30	
	40	8.176920	1399	8.176969	20	
	50	8.178319	1394	8.178368	10	
52		8.179713	1389	8.179763		8
	10	8.181102	1386	8.181152	50	
	20	8.182488	1381	8.182538	40	
	30	8.183869	1376	8.183919	30	
	40	8.185245	1372	8.185296	20	
	50	8.186617	1368	8.186668	10	
53		8.187985	1363	8.188036		7
	10	8.189348	1359	8.189400	50	
	20	8.190707	1355	8.190760	40	
	30	8.192062	1351	8.192115	30	
	40	8.193413	1347	8.193466	20	
	50	8.194760	1342	8.194813	10	
54		8.196102	1338	8.196156		6
	10	8.197440	1334	8.197494	50	
	20	8.198774	1330	8.198829	40	
	30	8.200104	1326	8.200159	30	
	40	8.201430	1322	8.201485	20	
	50	8.202752	1318	8.202808	10	
55		8.204070	1314	8.204126		5
	10	8.205384	1310	8.205440	50	
	20	8.206694	1306	8.206750	40	
	30	8.208000	1302	8.208057	30	
	40	8.209302	1299	8.209359	20	
	50	8.210601	1294	8.210658	10	
56		8.211895	1290	8.211953		4
	10	8.213185	1287	8.213243	50	
	20	8.214472	1283	8.214530	40	
	30	8.215755	1279	8.215814	30	
	40	8.217034	1275	8.217093	20	
	50	8.218309	1272	8.218369	10	
57		8.219581	1268	8.219641		3
	10	8.220849	1264	8.220909	50	
	20	8.222113	1261	8.222174	40	
	30	8.223374	1257	8.223435	30	
	40	8.224631	1253	8.224692	20	
	50	8.225884	1250	8.225945	10	
58		8.227134	1246	8.227195		2
	10	8.228380	1242	8.228442	50	
	20	8.229622	1239	8.229685	40	
	30	8.230861	1235	8.230924	30	
	40	8.232096	1232	8.232160	20	
	50	8.233328	1229	8.233392	10	
59		8.234557	1225	8.234621		1
	10	8.235782	1222	8.235846	50	
	20	8.237003	1218	8.237068	40	
	30	8.238221	1215	8.238286	30	
	40	8.239436	1211	8.239501	20	
	50	8.240647	1208	8.240713	10	
60		8.241855		8.241921		0
M	S	Co-sine.	Diff.	Co-tan.	S	M

89 Degrees.

TABLE XXV.

LOGARITHMIC SINES AND TANGENTS.

1 Degree.

M	S	Sine.	Diff.	Tang.	S	M
0	0	8.241855		8.241921		60
	10	8.243060	1205	8.243126	50	
	20	8.244261	1201	8.244328	40	
	30	8.245459	1198	8.245526	30	
	40	8.246654	1195	8.246721	20	
	50	8.247845	1191	8.247913	10	
1		8.249033	1188	8.249101		59
	10	8.250218	1185	8.250287	50	
	20	8.251400	1182	8.251469	40	
	30	8.252578	1178	8.252648	30	
	40	8.253753	1175	8.253823	20	
	50	8.254925	1172	8.254996	10	
2		8.256094	1169	8.256165		58
	10	8.257260	1166	8.257331	50	
	20	8.258423	1163	8.258494	40	
	30	8.259582	1159	8.259654	30	
	40	8.260739	1157	8.260811	20	
	50	8.261892	1153	8.261965	10	
3		8.263042	1150	8.263115		57
	10	8.264190	1148	8.264263	50	
	20	8.265334	1144	8.265408	40	
	30	8.266475	1141	8.266549	30	
	40	8.267613	1138	8.267688	20	
	50	8.268749	1136	8.268824	10	
4		8.269881	1132	8.269956		56
	10	8.271010	1129	8.271086	50	
	20	8.272137	1127	8.272213	40	
	30	8.273260	1124	8.273337	30	
	40	8.274381	1121	8.274458	20	
	50	8.275499	1118	8.275576	10	
5		8.276614	1115	8.276691		55
	10	8.277726	1112	8.277804	50	
	20	8.278835	1109	8.278913	40	
	30	8.279941	1106	8.280020	30	
	40	8.281045	1104	8.281124	20	
	50	8.282145	1101	8.282225	10	
6		8.283243	1098	8.283323		54
	10	8.284339	1096	8.284419	50	
	20	8.285431	1093	8.285512	40	
	30	8.286521	1090	8.286602	30	
	40	8.287608	1087	8.287689	20	
	50	8.288692	1084	8.288774	10	
7		8.289773	1081	8.289856		53
	10	8.290852	1079	8.290935	50	
	20	8.291929	1077	8.292012	40	
	30	8.293002	1073	8.293086	30	
	40	8.294073	1071	8.294157	20	
	50	8.295141	1068	8.295226	10	
8		8.296207	1066	8.296292		52
	10	8.297270	1063	8.297355	50	
	20	8.298330	1060	8.298416	40	
	30	8.299388	1058	8.299474	30	
	40	8.300443	1055	8.300530	20	
	50	8.301496	1053	8.301583	10	
9		8.302546	1050	8.302633		51
	10	8.303594	1048	8.303682	50	
	20	8.304639	1045	8.304727	40	
	30	8.305681	1042	8.305770	30	
	40	8.306721	1040	8.306811	20	
	50	8.307759	1038	8.307849	10	
10		8.308794	1035	8.308884		50
M	S	Co-sine.	Diff.	Co-tan.	S	M

88 Degrees.

1 Degree.

M	S	Sine.	Diff.	Tang.	S	M
10	0	8.308794		8.308884		50
	10	8.309827	1033	8.309917	50	
	20	8.310857	1030	8.310948	40	
	30	8.311885	1028	8.311976	30	
	40	8.312910	1025	8.313002	20	
	50	8.313933	1023	8.314025	10	
11		8.314954	1021	8.315046		49
	10	8.315972	1018	8.316065	50	
	20	8.316987	1015	8.317081	40	
	30	8.318001	1014	8.318095	30	
	40	8.319012	1011	8.319106	20	
	50	8.320020	1008	8.320115	10	
12		8.321027	1007	8.321122		48
	10	8.322031	1001	8.322127	50	
	20	8.323033	1002	8.323129	40	
	30	8.324032	999	8.324128	30	
	40	8.325029	997	8.325126	20	
	50	8.326024	995	8.326121	10	
13		8.327016	992	8.327114		47
	10	8.328007	991	8.328105	50	
	20	8.328995	988	8.329093	40	
	30	8.329980	986	8.330080	30	
	40	8.330961	984	8.331064	20	
	50	8.331945	981	8.332045	10	
14		8.332924	979	8.333025		46
	10	8.333901	977	8.334002	50	
	20	8.334876	975	8.334977	40	
	30	8.335848	972	8.335950	30	
	40	8 336819	971	8.336921	20	
	50	8.337787	968	8.337890	10	
15		8.338753	966	8.338856		45
	10	8.339717	964	8.339821	50	
	20	8.340678	961	8.340783	40	
	30	8.341638	960	8.341743	30	
	40	8.342596	958	8.342701	20	
	50	8.343551	955	8.343657	10	
16		8.344501	953	8.344610		44
	10	8.345455	951	8.345562	50	
	20	8.346405	950	8.346512	40	
	30	8.347352	947	8.347459	30	
	40	8.348297	945	8.348405	20	
	50	8.349240	943	8.349348	10	
17		8.350180	940	8.350289		43
	10	8.351119	939	8.351229	50	
	20	8.352056	937	8.352166	40	
	30	8.352991	935	8.353101	30	
	40	8.353924	933	8.354035	20	
	50	8.354855	931	8.354966	10	
18		8.355783	928	8.355895		42
	10	8.356710	927	8.356823	50	
	20	8.357635	925	8.357748	40	
	30	8.358558	923	8.358671	30	
	40	8.359479	921	8.359593	20	
	50	8.360398	919	8.360512	10	
19		8.361315	917	8.361430		41
	10	8.362230	915	8.362345	50	
	20	8.363143	913	8.363259	40	
	30	8.364054	911	8.364171	30	
	40	8.364964	910	8.365080	20	
	50	8.365871	907	8.365988	10	
20		8.366777	906	8.366894		40
M	S	Co-sine.	Diff.	Co-tan.	S	M

88 Degrees.

TABLE XXV.

LOGARITHMIC SINES AND TANGENTS.

1 Degree.

M	S	Sine.	Diff.	Tang.	S	M
20	0	8.366777		8.366894		40
	10	8.367681	904	8.367799	50	
	20	8.368582	901	8.368701	40	
	30	8.369482	900	8.369601	30	
	40	8.370380	898	8.370500	20	
	50	8.371277	897	8.371397	10	
21		8.372171	894	8.372291		39
	10	8.373064	893	8.373184	50	
	20	8.373955	891	8.374076	40	
	30	8.374843	888	8.374965	30	
	40	8.375730	887	8.375853	20	
	50	8.376615	885	8.376738	10	
22		8.377499	884	8.377622		38
	10	8.378380	881	8.378504	50	
	20	8.379260	880	8.379385	40	
	30	8.380138	878	8.380263	30	
	40	8.381015	877	8.381140	20	
	50	8.381889	874	8.382015	10	
23		8.382762	873	8.382889		37
	10	8.383633	871	8.383760	50	
	20	8.384502	869	8.384630	40	
	30	8.385370	868	8.385498	30	
	40	8.386236	866	8.386364	20	
	50	8.387100	864	8.387229	10	
24		8.387962	862	8.388092		36
	10	8.388823	861	8.388953	50	
	20	8.389682	859	8.389812	40	
	30	8.390539	857	8.390670	30	
	40	8.391395	856	8.391526	20	
	50	8.392249	854	8.392381	10	
25		8.393101	852	8.393234		35
	10	8.393951	850	8.394085	50	
	20	8.394860	849	8.394934	40	
	30	8.395647	847	8.395782	30	
	40	8.396493	846	8.396628	20	
	50	8.397337	844	8.397472	10	
26		8.398179	842	8.398315		34
	10	8.399020	841	8.399156	50	
	20	8.399859	839	8.399996	40	
	30	8.400696	837	8.400834	30	
	40	8.401532	836	8.401670	20	
	50	8.402366	834	8.402505	10	
27		8.403199	833	8.403338		33
	10	8.404030	831	8.404170	50	
	20	8.404859	829	8.405000	40	
	30	8.405687	828	8.405828	30	
	40	8.406513	826	8.406655	20	
	50	8.407338	825	8.407480	10	
28		8.408161	823	8.408304		32
	10	8.408983	822	8.409126	50	
	20	8.409803	820	8.409946	40	
	30	8.410621	818	8.410765	30	
	40	8.411438	817	8.411583	20	
	50	8.412254	816	8.412399	10	
29		8.413068	814	8.413213		31
	10	8.413880	812	8.414026	50	
	20	8.414691	811	8.414837	40	
	30	8.415500	809	8.415647	30	
	40	8.416308	808	8.416456	20	
	50	8.417114	806	8.417262	10	
30		8.417919	805	8.418068		30
M	S	Co-sine.	Diff.	Co-tan.	S	M

88 Degrees.

1 Degree.

M	S	Sine.	Diff.	Tang.	S	M
30	0	8.417919		8.418068		30
	10	8.418722	803	8.418872	50	
	20	8.419524	802	8.419674	40	
	30	8.420324	800	8.420475	30	
	40	8.421123	799	8.421274	20	
	50	8.421921	798	8.422073	10	
31		8.422717	796	8.422869		29
	10	8.423511	794	8.423664	50	
	20	8.424304	793	8.424458	40	
	30	8.425096	792	8.425250	30	
	40	8.425886	790	8.426040	20	
	50	8.426675	789	8.426830	10	
32		8.427462	787	8.427618		28
	10	8.428248	786	8.428404	50	
	20	8.429032	784	8.429189	40	
	30	8.429815	783	8.429973	30	
	40	8.430597	782	8.430755	20	
	50	8.431377	780	8.431536	10	
33		8.432156	779	8.432315		27
	10	8.432933	777	8.433093	50	
	20	8.433709	776	8.433870	40	
	30	8.434484	775	8.434645	30	
	40	8.435257	773	8.435419	20	
	50	8.436029	772	8.436191	10	
34		8.436800	771	8.436962		26
	10	8.437569	769	8.437732	50	
	20	8.438337	768	8.438500	40	
	30	8.439103	766	8.439267	30	
	40	8.439868	765	8.440033	20	
	50	8.440632	764	8.440797	10	
35		8.441394	762	8.441560		25
	10	8.442155	761	8.442322	50	
	20	8.442915	760	8.443082	40	
	30	8.443674	759	8.443841	30	
	40	8.444431	757	8.444599	20	
	50	8.445187	756	8.445355	10	
36		8.445941	754	8.446110		24
	10	8.446694	753	8.446864	50	
	20	8.447446	752	8.447616	40	
	30	8.448196	751	8.448367	30	
	40	8.448946	750	8.449117	20	
	50	8.449694	748	8.449866	10	
37		8.450440	747	8.450613		23
	10	8.451186	746	8.451359	50	
	20	8.451930	744	8.452104	40	
	30	8.452673	743	8.452847	30	
	40	8.453414	741	8.453589	20	
	50	8.454154	740	8.454330	10	
38		8.454893	739	8.455070		22
	10	8.455631	738	8.455808	50	
	20	8.456368	737	8.456545	40	
	30	8.457103	735	8.457281	30	
	40	8.457837	734	8.458016	20	
	50	8.458570	733	8.458749	10	
39		8.459301	732	8.459481		21
	10	8.460032	731	8.460212	50	
	20	8.460761	729	8.460942	40	
	30	8.461489	728	8.461671	30	
	40	8.462215	727	8.462398	20	
	50	8.462941	726	8.463124	10	
40		8.463665	724	8.463849		20
M	S	Co-sine.	Diff.	Co-tan.	S	M

88 Degrees.

LOGARITHMIC SINES AND TANGENTS.

1 Degree.

M	S	Sine.	Diff.	Tang.	S	M
40	0	8.463665		8.463849		20
	10	8.464388	723	8.464572	50	
	20	8.465110	722	8.465295	40	
	30	8.465830	721	8.466016	30	
	40	8.466550	720	8.466736	20	
	50	8.467268	718	8.467455	10	
41		8.467985	717	8.468172		19
	10	8.468701	716	8.468889	50	
	20	8.469416	715	8.469604	40	
	30	8.470129	714	8.470318	30	
	40	8.470841	713	8.471031	20	
	50	8.471553	712	8.471743	10	
42		8.472263	710	8.472454		18
	10	8.472971	709	8.473163	50	
	20	8.473679	708	8.473871	40	
	30	8.474386	707	8.474579	30	
	40	8.475091	706	8.475285	20	
	50	8.475795	704	8.475990	10	
43		8.476498	703	8.476693		17
	10	8.477200	702	8.477396	50	
	20	8.477901	701	8.478097	40	
	30	8.478601	700	8.478798	30	
	40	8.479299	699	8.479497	20	
	50	8.479997	698	8.480195	10	
44		8.480693	696	8.480892		16
	10	8.481388	695	8.481588	50	
	20	8.482082	694	8.482283	40	
	30	8.482775	693	8.482976	30	
	40	8.483467	692	8.483669	20	
	50	8.484158	691	8.484360	10	
45		8.484848	690	8.485050		15
	10	8.485537	689	8.485740	50	
	20	8.486224	687	8.486428	40	
	30	8.486910	686	8.487115	30	
	40	8.487596	686	8.487801	20	
	50	8.488280	684	8.488486	10	
46		8.488963	683	8.489170		14
	10	8.489645	682	8.489852	50	
	20	8.490326	681	8.490534	40	
	30	8.491006	680	8.491215	30	
	40	8.491685	679	8.491894	20	
	50	8.492363	678	8.492573	10	
47		8.493040	677	8.493250		13
	10	8.493716	676	8.493927	50	
	20	8.494390	675	8.494602	40	
	30	8.495064	674	8.495276	30	
	40	8.495736	673	8.495949	20	
	50	8.496408	672	8.496622	10	
48		8.497078	671	8.497293		12
	10	8.497748	670	8.497963	50	
	20	8.498416	669	8.498632	40	
	30	8.499084	668	8.499300	30	
	40	8.499750	667	8.499967	20	
	50	8.500415	666	8.500633	10	
49		8.501080	665	8.501298		11
	10	8.501743	664	8.501962	50	
	20	8.502405	663	8.502625	40	
	30	8.503067	662	8.503287	30	
	40	8.503727	660	8.503948	20	
	50	8.504386	659	8.504608	10	
50		8.505045	659	8.505267		10
M	S	Co-sine.	Diff.	Co-tan.	S	M

88 Degrees.

1 Degree.

M	S	Sine.	Diff.	Tang.	S	M
50	0	8.505045		8.505267		10
	10	8.505702	658	8.505925	50	
	20	8.506358	657	8.506582	40	
	30	8.507014	656	8.507238	30	
	40	8.507668	655	8.507893	20	
	50	8.508321	654	8.508547	10	
51		8.508974	653	8.509200		9
	10	8.509625	652	8.509852	50	
	20	8.510275	651	8.510503	40	
	30	8.510925	650	8.511153	30	
	40	8.511573	649	8.511802	20	
	50	8.512221	648	8.512451	10	
52		8.512867	647	8.513098		8
	10	8.513513	646	8.513744	50	
	20	8.514157	645	8.514389	40	
	30	8.514801	644	8.515034	30	
	40	8.515444	643	8.515677	20	
	50	8.516086	642	8.516320	10	
53		8.516726	641	8.516961		7
	10	8.517366	640	8.517602	50	
	20	8.518005	639	8.518241	40	
	30	8.518643	638	8.518880	30	
	40	8.519280	637	8.519517	20	
	50	8.519916	636	8.520154	10	
54		8.520551	635	8.520790		6
	10	8.521186	635	8.521425	50	
	20	8.521819	634	8.522059	40	
	30	8.522451	633	8.522692	30	
	40	8.523083	632	8.523324	20	
	50	8.523713	631	8.523956	10	
55		8.524343	630	8.524586		5
	10	8.524972	629	8.525215	50	
	20	8.525600	628	8.525814	40	
	30	8.526226	627	8.526472	30	
	40	8.526852	626	8.527098	20	
	50	8.527477	625	8.527724	10	
56		8.528102	625	8.528349		4
	10	8.528725	624	8.528973	50	
	20	8.529347	623	8.529596	40	
	30	8.529969	622	8.530218	30	
	40	8.530589	621	8.530840	20	
	50	8.531209	620	8.531460	10	
57		8.531828	619	8.532080		3
	10	8.532446	618	8.532698	50	
	20	8.533063	617	8.533316	40	
	30	8.533679	616	8.533933	30	
	40	8.534295	616	8.534549	20	
	50	8.534909	615	8.535164	10	
58		8.535523	614	8.535779		2
	10	8.536136	613	8.536392	50	
	20	8.536747	612	8.537005	40	
	30	8.537359	611	8.537616	30	
	40	8.537969	610	8.538227	20	
	50	8.538578	609	8.538837	10	
59		8.539186	608	8.539447		1
	10	8.539794	608	8.540055	50	
	20	8.540401	607	8.540662	40	
	30	8.541007	606	8.541269	30	
	40	8.541612	605	8.541875	20	
	50	8.542216	604	8.542480	10	
60		8.542819	603	8.543084		0
M	S	Co-sine.	Diff.	Co-tan.	S	M

88 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

0 Degree.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	0.000000		10.000000	00	0.000000		Infinite.	10.000000	Infinite.	60
1	6.463726	501717	10.000000	00	6.463726	501717	13.536274	10.000000	13.536274	59
2	6.764756	293485	10.000000	00	6.764756	293485	13.235244	10.000000	13.235244	58
3	6.940847	208231	10.000000	00	6.940847	208231	13.059153	10.000000	13.059153	57
4	7.065786	161517	10.000000	00	7.065786	161517	12.934214	10.000000	12.934214	56
5	7.162696	131968	10.000000	00	7.162696	131969	12.837304	10.000000	12.837304	55
6	7.241877	111578	9.999999	00	7.241878	111578	12.758122	10.000001	12.758123	54
7	7.308824	96653	9.999999	00	7.308825	96653	12.691175	10.000001	12.691176	53
8	7.366816	85254	9.999999	00	7.366817	85254	12.633183	10.000001	12.633184	52
9	7.417968	76262	9.999999	01	7.417970	76263	12.582030	10.000001	12.582032	51
10	7.463726	68988	9.999998	00	7.463727	68988	12.536273	10.000002	12.536274	50
11	7.505118	62981	9.999998	01	7.505120	62981	12.494880	10.000002	12.494882	49
12	7.542906	57936	9.999997	00	7.542909	57937	12.457091	10.000003	12.457094	48
13	7.577668	53641	9.999997	01	7.577672	53642	12.422328	10.000003	12.422332	47
14	7.609853	49938	9.999996	00	7.609857	49939	12.390143	10.000004	12.390147	46
15	7.639816	46714	9.999996	01	7.639820	46715	12.360180	10.000004	12.360184	45
16	7.667845	43881	9.999995	00	7.667849	43882	12.332151	10.000005	12.332155	44
17	7.694173	41372	9.999995	01	7.694179	41373	12.305821	10.000005	12.305827	43
18	7.718997	39135	9.999994	01	7.719003	39136	12.280997	10.000006	12.281003	42
19	7.742478	37127	9.999993	00	7.742484	37128	12.257516	10.000007	12.257522	41
20	7.764754	35315	9.999993	01	7.764761	35315	12.235239	10.000007	12.235246	40
21	7.785943	33672	9.999992	01	7.785951	33673	12.214049	10.000008	12.214057	39
22	7.806146	32175	9.999991	01	7.806155	32176	12.193845	10.000009	12.193854	38
23	7.825451	30805	9.999990	01	7.825460	30807	12.174540	10.000010	12.174549	37
24	7.843934	29547	9.999989	01	7.843944	29549	12.156056	10.000011	12.156066	36
25	7.861662	28388	9.999989	00	7.861674	28390	12.138326	10.000011	12.138338	35
26	7.878695	27317	9.999988	01	7.878708	27318	12.121292	10.000012	12.121305	34
27	7.895085	26323	9.999987	01	7.895099	26325	12.104901	10.000013	12.104915	33
28	7.910879	25399	9.999986	01	7.910894	25401	12.089106	10.000014	12.089121	32
29	7.926119	24538	9.999985	01	7.926134	24540	12.073866	10.000015	12.073881	31
30	7.940842	23733	9.999983	03	7.940858	23735	12.059142	10.000017	12.059158	30
31	7.955082	22980	9.999982	01	7.955100	22982	12.044900	10.000018	12.044918	29
32	7.968870	22273	9.999981	01	7.968889	22275	12.031111	10.000019	12.031130	28
33	7.982233	21608	9.999980	01	7.982253	21610	12.017747	10.000020	12.017767	27
34	7.995198	20981	9.999979	03	7.995219	20983	12.004781	10.000021	12.004802	26
35	8.007787	20390	9.999977	01	8.007809	20392	11.992191	10.000023	11.992213	25
36	8.020021	19831	9.999976	01	8.020045	19833	11.979955	10.000024	11.979979	24
37	8.031919	19302	9.999975	01	8.031945	19305	11.968055	10.000025	11.968081	23
38	8.043501	18801	9.999973	03	8.043527	18803	11.956473	10.000027	11.956499	22
39	8.054781	18325	9.999972	01	8.054809	18327	11.945191	10.000028	11.945219	21
40	8.065776	17872	9.999971	03	8.065806	17875	11.934194	10.000029	11.934224	20
41	8.076500	17441	9.999969	01	8.076531	17444	11.923469	10.000031	11.923500	19
42	8.086965	17031	9.999968	03	8.086997	17034	11.913003	10.000032	11.913035	18
43	8.097183	16639	9.999966	03	8.097217	16642	11.902783	10.000034	11.902817	17
44	8.107167	16265	9.999964	01	8.107202	16268	11.892798	10.000036	11.892833	16
45	8.116926	15908	9.999963	03	8.116963	15911	11.883037	10.000037	11.883074	15
46	8.126471	15566	9.999961	03	8.126510	15568	11.873490	10.000039	11.873529	14
47	8.135810	15238	9.999959	01	8.135851	15241	11.864149	10.000041	11.864190	13
48	8.144953	14924	9.999958	03	8.144996	14927	11.855004	10.000042	11.855047	12
49	8.153907	14622	9.999956	03	8.153952	14625	11.846048	10.000044	11.846093	11
50	8.162681	14333	9.999954	03	8.162727	14336	11.837273	10.000046	11.837319	10
51	8.171280	14054	9.999952	03	8.171328	14057	11.828672	10.000048	11.828720	9
52	8.179713	13786	9.999950	03	8.179763	13790	11.820237	10.000050	11.820287	8
53	8.187985	13529	9.999948	03	8.188036	13532	11.811964	10.000052	11.812015	7
54	8.196102	13280	9.999946	03	8.196156	13284	11.803844	10.000054	11.803898	6
55	8.204070	13041	9.999944	03	8.204126	13044	11.795874	10.000056	11.795930	5
56	8.211895	12810	9.999942	03	8.211953	12814	11.788047	10.000058	11.788105	4
57	8.219581	12587	9.999940	03	8.219641	12591	11.780359	10.000060	11.780419	3
58	8.227134	12372	9.999938	03	8.227195	12376	11.772805	10.000062	11.772866	2
59	8.234557	12164	9.999936	03	8.234621	12168	11.765379	10.000064	11.765443	1
60	8.241855		9.999934		8.241922		11.758078	10.000066	11.758145	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

89 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

1 Degree.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	8.241855	11963	9.999934	03	8.241921	11967	11.758079	10.000066	11.758145	60
1	8.249033	11768	9.999932	05	8.249102	11772	11.750898	10.000068	11.750967	59
2	8.256094	11580	9.999929	03	8.256165	11584	11.743835	10.000071	11.743906	58
3	8.263042	11397	9.999927	03	8.263115	11402	11.736885	10.000073	11.736958	57
4	8.269881	11221	9.999925	05	8.269956	11225	11.730044	10.000075	11.730119	56
5	8.276614	11050	9.999922	03	8.276691	11054	11.723309	10.000078	11.723386	55
6	8.283243	10883	9.999920	05	8.283323	10887	11.716677	10.000080	11.716757	54
7	8.289773	10722	9.999918	03	8.289856	10726	11.710144	10.000082	11.710227	53
8	8.296207	10565	9.999915	05	8.296292	10570	11.703708	10.000085	11.703793	52
9	8.302546	10413	9.999913	03	8.302634	10418	11.697366	10.000087	11.697454	51
10	8.308794	10266	9.999910	05	8.308884	10270	11.691116	10.000090	11.691206	50
11	8.314954	10122	9.999907	03	8.315046	10126	11.684954	10.000093	11.685046	49
12	8.321027	9982	9.999905	05	8.321122	9987	11.678878	10.000095	11.678973	48
13	8.327016	9847	9.999902	05	8.327114	9851	11.672886	10.000098	11.672984	47
14	8.332924	9714	9.999899	03	8.333025	9719	11.666975	10.000101	11.667076	46
15	8.338753	9586	9.999897	05	8.338856	9590	11.661144	10.000103	11.661247	45
16	8.344504	9460	9.999894	05	8.344610	9465	11.655390	10.000106	11.655496	44
17	8.350181	9338	9.999891	05	8.350289	9343	11.649711	10.000109	11.649819	43
18	8.355783	9219	9.999888	05	8.355895	9224	11.644105	10.000112	11.644217	42
19	8.361315	9103	9.999885	05	8.361430	9108	11.638570	10.000115	11.638685	41
20	8.366777	8990	9.999882	05	8.366895	8995	11.633105	10.000118	11.633223	40
21	8.372171	8880	9.999879	05	8.372292	8885	11.627708	10.000121	11.627829	39
22	8.377499	8772	9.999876	05	8.377622	8777	11.622378	10.000124	11.622501	38
23	8.382762	8667	9.999873	05	8.382889	8672	11.617111	10.000127	11.617238	37
24	8.387962	8564	9.999870	05	8.388092	8570	11.611908	10.000130	11.612038	36
25	8.393101	8464	9.999867	05	8.393234	8470	11.606766	10.000133	11.606899	35
26	8.398179	8366	9.999864	05	8.398315	8371	11.601685	10.000136	11.601821	34
27	8.403199	8271	9.999861	05	8.403338	8276	11.596662	10.000139	11.596801	33
28	8.408161	8177	9.999858	07	8.408304	8182	11.591696	10.000142	11.591839	32
29	8.413068	8086	9.999854	05	8.413213	8091	11.586787	10.000146	11.586932	31
30	8.417919	7996	9.999851	05	8.418068	8002	11.581932	10.000149	11.582081	30
31	8.422717	7909	9.999848	07	8.422869	7914	11.577131	10.000152	11.577283	29
32	8.427462	7823	9.999844	05	8.427618	7829	11.572382	10.000156	11.572538	28
33	8.432156	7740	9.999841	05	8.432315	7745	11.567685	10.000159	11.507844	27
34	8.436800	7657	9.999838	07	8.436962	7663	11.563038	10.000162	11.563200	26
35	8.441394	7577	9.999834	05	8.441560	7583	11.558440	10.000166	11.558606	25
36	8.445941	7499	9.999831	07	8.446110	7505	11.553890	10.000169	11.554059	24
37	8.450440	7422	9.999827	07	8.450613	7428	11.549387	10.000173	11.549560	23
38	8.454893	7346	9.999824	05	8.455070	7352	11.544930	10.000176	11.545107	22
39	8.459301	7273	9.999820	07	8.459481	7279	11.540519	10.000180	11.540699	21
40	8.463665	7200	9.999816	07	8.463849	7206	11.536151	10.000184	11.536335	20
41	8.467985	7129	9.999813	05	8.468172	7135	11.531828	10.000187	11.532015	19
42	8.472263	7060	9.999809	07	8.472454	7066	11.527546	10.000191	11.527737	18
43	8.476498	6991	9.999805	07	8.476693	6998	11.523307	10.000195	11.523502	17
44	8.480693	6924	9.999801	07	8.480892	6931	11.519108	10.000199	11.519307	16
45	8.484848	6859	9.999797	07	8.485050	6865	11.514950	10.000203	11.515152	15
46	8.488963	6794	9.999794	05	8.489170	6801	11.510830	10.000206	11.511037	14
47	8.493040	6731	9.999790	07	8.493250	6738	11.506750	10.000210	11.506960	13
48	8.497078	6669	9.999786	07	8.497293	6676	11.502707	10.000214	11.502922	12
49	8.501080	6608	9.999782	07	8.501298	6615	11.498702	10.000218	11.498920	11
50	8.505045	6548	9.999778	07	8.505267	6555	11.494733	10.000222	11.494955	10
51	8.508974	6489	9.999774	08	8.509200	6496	11.490800	10.000226	11.491026	9
52	8.512867	6432	9.999769	07	8.513098	6439	11.486902	10.000231	11.487133	8
53	8.516726	6375	9.999765	07	8.516961	6382	11.483039	10.000235	11.485274	7
54	8.520551	6319	9.999761	07	8.520790	6326	11.479210	10.000239	11.479419	6
55	8.524343	6264	9.999757	07	8.524586	6272	11.475414	10.000243	11.475657	5
56	8.528102	6211	9.999753	08	8.528349	6218	11.471651	10.000247	11.471898	4
57	8.531828	6158	9.999748	07	8.532080	6165	11.467920	10.000252	11.468172	3
58	8.535523	6106	9.999744	07	8.535779	6113	11.464221	10.000256	11.464477	2
59	8.539186	6055	9.999740	08	8.539447	6062	11.460553	10.000260	11.460814	1
60	8.542819		9.990735		8.543084		11.456916	10.000265	11.457181	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

88 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

2 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	8.542819	6004	9.999735	07	8.543084	6012	11.456916	10.000265	11.457181	60
1	8.546422	5955	9.999731	07	8.546691	5962	11.453309	10.000269	11.453578	59
2	8.549995	5906	9.999726	08	8.550268	5914	11.449732	10.000274	11.450005	58
3	8.553539	5858	9.999722	08	8.553817	5866	11.446183	10.000278	11.446461	57
4	8.557054	5811	9.999717	07	8.557336	5819	11.442664	10.000283	11.442946	56
5	8.560540	5765	9.999713	08	8.560828	5773	11.439172	10.000287	11.439460	55
6	8.563999	5719	9.999708	07	8.564291	5727	11.435709	10.000292	11.436001	54
7	8.567431	5674	9.999704	08	8.567727	5682	11.432273	10.000296	11.432569	53
8	8.570836	5630	9.999699	08	8.571137	5638	11.428863	10.000301	11.429164	52
9	8.574214	5587	9.999694	08	8.574520	5595	11.425480	10.000306	11.425786	51
10	8.577566	5544	9.999689	07	8.577877	5552	11.422123	10.000311	11.422434	50
11	8.580892	5502	9.999685	08	8.581208	5510	11.418792	10.000315	11.419108	49
12	8.584193	5460	9.999680	08	8.584514	5468	11.415486	10.000320	11.415807	48
13	8.587469	5419	9.999675	08	8.587795	5427	11.412205	10.000325	11.412531	47
14	8.590721	5379	9.999670	08	8.591051	5387	11.408949	10.000330	11.409279	46
15	8.593948	5339	9.999665	08	8.594283	5347	11.405717	10.000335	11.406052	45
16	8.597152	5300	9.999660	08	8.597492	5308	11.402508	10.000340	11.402848	44
17	8.600332	5261	9.999655	08	8.600677	5270	11.399323	10.000345	11.399668	43
18	8.603489	5223	9.999650	08	8.603839	5232	11.396161	10.000350	11.396511	42
19	8.606623	5186	9.999645	08	8.606978	5194	11.393022	10.000355	11.393377	41
20	8.609734	5149	9.999640	08	8.610094	5158	11.389906	10.000360	11.390266	40
21	8.612823	5112	9.999635	10	8.613189	5121	11.386811	10.000365	11.387177	39
22	8.615891	5076	9.999629	08	8.616262	5085	11.383738	10.000371	11.384109	38
23	8.618937	5041	9.999624	08	8.619313	5050	11.380687	10.000376	11.381063	37
24	8.621962	5006	9.999619	08	8.622343	5015	11.377657	10.000381	11.378038	36
25	8.624965	4972	9.999614	10	8.625352	4981	11.374648	10.000386	11.375035	35
26	8.627948	4938	9.999608	08	8.628340	4947	11.371660	10.000392	11.372052	34
27	8.630911	4904	9.999603	10	8.631308	4913	11.368692	10.000397	11.369089	33
28	8.633854	4871	9.999597	08	8.634256	4880	11.365744	10.000403	11.366146	32
29	8.636776	4839	9.999592	08	8.637184	4848	11.362816	10.000408	11.363224	31
30	8.639680	4806	9.999586	10	8.640093	4816	11.359907	10.000414	11.360320	30
31	8.642563	4775	9.999581	10	8.642982	4784	11.357018	10.000419	11.357437	29
32	8.645428	4743	9.999575	08	8.645853	4753	11.354147	10.000425	11.354572	28
33	8.648274	4712	9.999570	10	8.648704	4722	11.351296	10.000430	11.351726	27
34	8.651102	4682	9.999564	10	8.651537	4691	11.348463	10.000436	11.348898	26
35	8.653911	4652	9.999558	08	8.654352	4661	11.345648	10.000442	11.346089	25
36	8.656702	4622	9.999553	10	8.657149	4631	11.342851	10.000447	11.343298	24
37	8.659475	4592	9.999547	10	8.659928	4602	11.340072	10.000453	11.340525	23
38	8.662230	4563	9.999541	10	8.662689	4573	11.337311	10.000459	11.337770	22
39	8.664968	4535	9.999535	10	8.665433	4544	11.334567	10.000465	11.335032	21
40	8.667689	4506	9.999529	08	8.668160	4516	11.331840	10.000471	11.332311	20
41	8.670393	4479	9.999524	10	8.670870	4488	11.329130	10.000476	11.329607	19
42	8.673080	4451	9.999518	10	8.673563	4461	11.326437	10.000482	11.326920	18
43	8.675751	4424	9.999512	10	8.676239	4434	11.323761	10.000488	11.324249	17
44	8.678405	4397	9.999506	10	8.678900	4407	11.321100	10.000494	11.321595	16
45	8.681043	4370	9.999500	10	8.681544	4380	11.318456	10.000500	11.318957	15
46	8.683665	4344	9.999493	12	8.684172	4354	11.315828	10.000507	11.316335	14
47	8.686272	4318	9.999487	10	8.686784	4328	11.313216	10.000513	11.313728	13
48	8.688863	4292	9.999481	10	8.689381	4303	11.310619	10.000519	11.311137	12
49	8.691438	4267	9.999475	10	8.691963	4277	11.308037	10.000525	11.308562	11
50	8.693998	4242	9.999469	12	8.694529	4252	11.305471	10.000531	11.306002	10
51	8.696543	4217	9.999463	10	8.697081	4228	11.302919	10.000537	11.303457	9
52	8.699073	4192	9.999456	10	8.699617	4203	11.300383	10.000544	11.300927	8
53	8.701589	4168	9.999450	10	8.702139	4179	11.297861	10.000550	11.298411	7
54	8.704090	4144	9.999443	12	8.704646	4155	11.295354	10.000557	11.295910	6
55	8.706577	4121	9.999437	10	8.707140	4132	11.292860	10.000563	11.293423	5
56	8.709049	4097	9.999431	12	8.709618	4108	11.290382	10.000569	11.290951	4
57	8.711507	4074	9.999424	10	8.712083	4085	11.287917	10.000576	11.288493	3
58	8.713952	4052	9.999418	12	8.714534	4062	11.285466	10.000582	11.286048	2
59	8.716383	4029	9.999411	12	8.716972	4040	11.283028	10.000589	11.283617	1
60	8.718800		9.999404		8.719396		11.280604	10.000596	11.281200	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

87 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

3 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	8.718800	4006	9.999404	10	8.719396	4017	11.280604	10.000596	11.281200	60
1	8.721204	3984	9.999398	12	8.721806	3995	11.278194	10.000602	11.278796	59
2	8.723595	3962	9.999391	12	8.721294	3974	11.275796	10.000609	11.276405	58
3	8.725972	3941	9.999384	10	8.726588	3952	11.273412	10.000616	11.274028	57
4	8.728337	3919	9.999378	12	8.728959	3931	11.271041	10.000622	11.271663	56
5	8.730688	3898	9.999371	12	8.731317	3909	11.268683	10.000629	11.269312	55
6	8.733027	3877	9.999364	12	8.733663	3889	11.266337	10.000636	11.266973	54
7	8.735354	3857	9.999357	12	8.735996	3868	11.264004	10.000643	11.264646	53
8	8.737667	3836	9.999350	12	8.738317	3848	11.261683	10.000650	11.262333	52
9	8.739969	3816	9.999343	12	8.740626	3827	11.259374	10.000657	11.260031	51
10	8.742259	3796	9.999336	12	8.742922	3807	11.257078	10.000664	11.257741	50
11	8.744536	3776	9.999329	12	8.745207	3787	11.254793	10.000671	11.255464	49
12	8.746802	3756	9.999322	12	8.747479	3768	11.252521	10.000678	11.253198	48
13	8.749055	3737	9.999315	12	8.749740	3749	11.250260	10.000685	11.250945	47
14	8.751297	3717	9.999308	12	8.751989	3729	11.248011	10.000692	11.248703	46
15	8.753528	3698	9.999301	12	8.754227	3710	11.245773	10.000699	11.246472	45
16	8.755747	3679	9.999294	13	8.756453	3692	11.243547	10.000706	11.244253	44
17	8.757955	3661	9.999287	12	8.758668	3673	11.241332	10.000713	11.242045	43
18	8.760151	3642	9.999279	12	8.760872	3655	11.239128	10.000721	11.239849	42
19	8.762337	3624	9.999272	12	8.763065	3636	11.236935	10.000728	11.237663	41
20	8.764511	3606	9.999265	13	8.765246	3618	11.234754	10.000735	11.235489	40
21	8.766675	3588	9.999257	12	8.767417	3600	11.232583	10.000743	11.233325	39
22	8.768828	3570	9.999250	13	8.769578	3583	11.230422	10.000750	11.231172	38
23	8.770970	3553	9.999242	12	8.771727	3565	11.228273	10.000758	11.229030	37
24	8.773101	3535	9.999235	13	8.773866	3548	11.226134	10.000765	11.226899	36
25	8.775223	3518	9.999227	12	8.775995	3531	11.224005	10.000773	11.224777	35
26	8.777333	3501	9.999220	13	8.778114	3514	11.221886	10.000780	11.222667	34
27	8.779434	3484	9.999212	13	8.780222	3497	11.219778	10.000788	11.220566	33
28	8.781524	3467	9.999205	13	8.782320	3480	11.217680	10.000795	11.218476	32
29	8.783605	3451	9.999197	13	8.784408	3464	11.215592	10.000803	11.216395	31
30	8.785675	3434	9.999189	13	8.786486	3447	11.213514	10.000811	11.214325	30
31	8.787736	3418	9.999181	12	8.788554	3431	11.211446	10.000819	11.212264	29
32	8.789787	3402	9.999174	13	8.790613	3415	11.209387	10.000826	11.210213	28
33	8.791828	3386	9.999166	13	8.792662	3899	11.207338	10.000834	11.208172	27
34	8.793859	3370	9.999158	13	8.794701	3383	11.205299	10.000842	11.206141	26
35	8.795881	3354	9.999150	13	8.796731	3368	11.203269	10.000850	11.204119	25
36	8.797894	3339	9.999142	13	8.798752	3352	11.201248	10.000858	11.202106	24
37	8.799897	3323	9.999134	13	8.800763	3337	11.199237	10.000866	11.200103	23
38	8.801892	3308	9.999126	13	8.802765	3322	11.197235	10.000874	11.198108	22
39	8.803876	3293	9.999118	13	8.804758	3306	11.195242	10.000882	11.196124	21
40	8.805852	3278	9.999110	13	8.806742	3292	11.193258	10.000890	11.194148	20
41	8.807819	3263	9.999102	13	8.808717	3277	11.191283	10.000898	11.192181	19
42	8.809777	3249	9.999094	13	8.810683	3262	11.189317	10.000906	11.190223	18
43	8.811726	3234	9.999086	15	8.812641	3248	11.187359	10.000914	11.188274	17
44	8.813667	3219	9.999077	13	8.814589	3233	11.185411	10.000923	11.186333	16
45	8.815599	3205	9.999069	13	8.816529	3219	11.183471	10.000931	11.184401	15
46	8.817522	3191	9.999061	15	8.818461	3205	11.181539	10.000939	11.182478	14
47	8.819436	3177	9.999053	13	8.820384	3191	11.179616	10.000947	11.180564	13
48	8.821343	3163	9.999044	13	8.822298	3177	11.177702	10.000956	11.178657	12
49	8.823240	3149	9.999036	15	8.824205	3163	11.175795	10.000964	11.176760	11
50	8.825130	3135	9.999027	13	8.826103	3150	11.173897	10.000973	11.174870	10
51	8.827011	3122	9.999019	15	8.827992	3136	11.172008	10.000981	11.172989	9
52	8.828884	3108	9.999010	13	8.829874	3123	11.170126	10.000990	11.171116	8
53	8.830749	3095	9.999002	15	8.831748	3109	11.168252	10.000998	11.169251	7
54	8.832607	3082	9.998993	15	8.833613	3096	11.166387	10.001007	11.167393	6
55	8.834456	3069	9.998984	13	8.835471	3083	11.164529	10.001016	11.165544	5
56	8.836297	3056	9.998976	15	8.837321	3070	11.162679	10.001024	11.163703	4
57	8.838130	3043	9.998967	15	8.839163	3057	11.160837	10.001033	11.161870	3
58	8.839956	3030	9.998958	13	8.840998	3045	11.159002	10.001042	11.160044	2
59	8.841774	3017	9.998950	15	8.842825	3032	11.157175	10.001050	11.158226	1
60	8.843585		9.998941		8.844614		11.155356	10.001059	11.156415	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

86 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

4 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	8.843585	3005	9.998941	15	8.844644	3019	11.155356	10.001059	11.156415	60
1	8.845387	2992	9.998932	15	8.846455	3007	11.153545	10.001068	11.154613	59
2	8.847183	2980	9.998923	15	8.848260	2995	11.151740	10.001077	11.152817	58
3	8.848971	2967	9.998914	15	8.850057	2982	11.149943	10.001086	11.151029	57
4	8.850751	2955	9.998905	15	8.851846	2970	11.148154	10.001095	11.149249	56
5	8.852525	2943	9.998896	15	8.853628	2958	11.146372	10.001104	11.147475	55
6	8.854291	2931	9.998887	15	8.855403	2946	11.144597	10.001113	11.145709	54
7	8.856049	2919	9.998878	15	8.857171	2935	11.142829	10.001122	11.143951	53
8	8.857801	2908	9.998869	15	8.858932	2923	11.141068	10.001131	11.142199	52
9	8.859546	2896	9.998860	15	8.860686	2911	11.139314	10.001140	11.140454	51
10	8.861283	2884	9.998851	17	8.862433	2900	11.137567	10.001149	11.138717	50
11	8.863014	2873	9.998841	15	8.864173	2888	11.135827	10.001159	11.136986	49
12	8.864738	2861	9.998832	15	8.865906	2877	11.134094	10.001168	11.135262	48
13	8.866455	2850	9.998823	17	8.867632	2866	11.132368	10.001177	11.133545	47
14	8.868165	2839	9.998813	15	8.869351	2854	11.130649	10.001187	11.131835	46
15	8.869868	2828	9.998804	15	8.871064	2843	11.128936	10.001196	11.130132	45
16	8.871565	2817	9.998795	17	8.872770	2832	11.127230	10.001205	11.128435	44
17	8.873255	2806	9.998785	15	8.874469	2821	11.125531	10.001215	11.126745	43
18	8.874938	2795	9.998776	17	8.876162	2811	11.123838	10.001224	11.125062	42
19	8.876615	2781	9.998766	15	8.877849	2800	11.122151	10.001234	11.123385	41
20	8.878285	2773	9.998757	17	8.879529	2789	11.120471	10.001243	11.121715	40
21	8.879949	2763	9.998747	17	8.881202	2779	11.118798	10.001253	11.120051	39
22	8.881607	2752	9.998738	15	8.882869	2768	11.117131	10.001262	11.118393	38
23	8.883258	2742	9.998728	17	8.884530	2758	11.115470	10.001272	11.116742	37
24	8.884903	2731	9.998718	17	8.886185	2747	11.113815	10.001282	11.115097	36
25	8.886542	2721	9.998708	15	8.887833	2737	11.112167	10.001292	11.113458	35
26	8.888174	2711	9.998699	17	8.889476	2727	11.110524	10.001301	11.111826	34
27	8.889801	2700	9.998689	17	8.891112	2717	11.108888	10.001311	11.110199	33
28	8.891421	2690	9.998679	17	8.892742	2707	11.107258	10.001321	11.168579	32
29	8.893035	2680	9.998669	17	8.894366	2697	11.105634	10.001331	11.106965	31
30	8.894643	2670	9.998659	17	8.895984	2687	11.104016	10.001341	11.105357	30
31	8.896246	2660	9.998649	17	8.897596	2677	11.102404	10.001351	11.103754	29
32	8.897842	2651	9.998639	17	8.899203	2667	11.100797	10.001361	11.102158	28
33	8.899432	2641	9.998629	17	8.900803	2658	11.099197	10.001371	11.100568	27
34	8.901017	2631	9.998619	17	8.902398	2648	11.097602	10.001381	11.098983	26
35	8.902596	2622	9.998609	17	8.903987	2638	11.096013	10.001391	11.097404	25
36	8.904169	2612	9.998599	17	8.905570	2629	11.094430	10.001401	11.095831	24
37	8.905736	2603	9.998589	18	8.907147	2620	11.092853	10.001411	11.094264	23
38	8.907297	2593	9.998578	17	8.908719	2610	11.091281	10.001422	11.092703	22
39	8.908853	2584	9.998568	17	8.910285	2601	11.089715	10.001432	11.091147	21
40	8.910404	2575	9.998558	17	8.911846	2592	11.088154	10.001442	11.089596	20
41	8.911949	2566	9.998548	18	8.913401	2583	11.086599	10.001452	11.088051	19
42	8.913488	2556	9.998537	17	8.914951	2574	11.085049	10.001463	11.086512	18
43	8.915022	2547	9.998527	18	8.916495	2565	11.083505	10.001473	11.084978	17
44	8.916550	2538	9.998516	17	8.918034	2556	11.081966	10.001484	11.083450	16
45	8.918073	2529	9.998506	18	8.919568	2547	11.080432	10.001494	11.081927	15
46	8.919591	2520	9.998495	17	8.921096	2538	11.078904	10.001505	11.080409	14
47	8.921103	2512	9.998485	18	8.922619	2530	11.077381	10.001515	11.078897	13
48	8.922610	2503	9.998474	17	8.924136	2521	11.075864	10.001526	11.077390	12
49	8.924112	2494	9.998464	18	8.925649	2512	11.074351	10.001536	11.075888	11
50	8.925609	2486	9.998453	18	8.927156	2503	11.072844	10.001547	11.074391	10
51	8.927100	2477	9.998442	18	8.928658	2495	11.071342	10.001558	11.072900	9
52	8.928587	2469	9.998431	17	8.930155	2486	11.069845	10.001569	11.071413	8
53	8.930068	2460	9.998421	18	8.931647	2478	11.068353	10.001579	11.069932	7
54	8.931544	2452	9.998410	18	8.933134	2470	11.066866	10.001590	11.068456	6
55	8.933015	2443	9.998399	18	8.934616	2461	11.065384	10.001601	11.066985	5
56	8.934481	2435	9.998388	18	8.936093	2453	11.063907	10.001612	11.065519	4
57	8.935942	2427	9.998377	18	8.937565	2445	11.062435	10.001623	11.064058	3
58	8.937398	2419	9.998366	18	8.939032	2437	11.060968	10.001634	11.062602	2
59	8.938850	2411	9.998355	18	8.940494	2429	11.059506	10.001645	11.061150	1
60	8.940296		9.998344		8.941952		11.058048	10.001656	11.059704	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

85 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

5 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	8.940296	2403	9.998344	18	8.941952	2421	11.058048	10.001656	11.059704	60
1	8.941738	2394	9.998333	18	8.943401	2413	11.056596	10.001667	11.058262	59
2	8.943174	2387	9.998322	18	8.944852	2405	11.055148	10.001678	11.056826	58
3	8.944606	2379	9.998311	18	8.946295	2397	11.053705	10.001689	11.055394	57
4	8.946034	2371	9.998300	18	8.947734	2390	11.052266	10.001700	11.053966	56
5	8.947456	2363	9.998289	20	8.949168	2382	11.050832	10.001711	11.052544	55
6	8.948874	2355	9.998277	18	8.950597	2374	11.049403	10.001723	11.051126	54
7	8.950287	2348	9.998266	18	8.952021	2366	11.047979	10.001734	11.049713	53
8	8.951696	2340	9.998255	20	8.953441	2359	11.046559	10.001745	11.048304	52
9	8.953100	2332	9.998243	18	8.954856	2351	11.045144	10.001757	11.046900	51
10	8.954499	2325	9.998232	20	8.956267	2344	11.043733	10.001768	11.045501	50
11	8.955894	2317	9.998220	18	8.957674	2336	11.042326	10.001780	11.044106	49
12	8.957284	2310	9.998209	20	8.959075	2329	11.040925	10.001791	11.042716	48
13	8.958670	2302	9.998197	18	8.960473	2322	11.039527	10.001803	11.041330	47
14	8.960052	2295	9.998186	20	8.961866	2314	11.038134	10.001814	11.039948	46
15	8.961429	2288	9.998174	18	8.963255	2307	11.036745	10.001826	11.038571	45
16	8.962801	2280	9.998163	20	8.964639	2300	11.035361	10.001837	11.037199	44
17	8.964170	2273	9.998151	20	8.966019	2293	11.033981	10.001849	11.035830	43
18	8.965534	2266	9.998139	18	8.967394	2286	11.032606	10.001861	11.034466	42
19	8.966893	2259	9.998128	20	8.968766	2279	11.031234	10.001872	11.033107	41
20	8.968249	2252	9.998116	20	8.970133	2271	11.029867	10.001884	11.031751	40
21	8.969600	2245	9.998104	20	8.971496	2265	11.028504	10.001896	11.030400	39
22	8.970947	2238	9.998092	20	8.972855	2257	11.027145	10.001908	11.029053	38
23	8.972289	2231	9.998080	20	8.974209	2251	11.025791	10.001920	11.027711	37
24	8.973628	2224	9.998068	20	8.975560	2244	11.024440	10.001932	11.026372	36
25	8.974962	2217	9.998056	20	8.976906	2237	11.023094	10.001944	11.025038	35
26	8.976293	2210	9.998044	20	8.978248	2230	11.021752	10.001956	11.023707	34
27	8.977619	2203	9.998032	20	8.979586	2223	11.020414	10.001968	11.022381	33
28	8.978941	2197	9.998020	20	8.980921	2217	11.019079	10.001980	11.021059	32
29	8.980259	2190	9.998008	20	8.982251	2210	11.017749	10.001992	11.019741	31
30	8.981573	2183	9.997996	20	8.983577	2204	11.016423	10.002004	11.018427	30
31	8.982883	2177	9.997984	20	8.984899	2197	11.015101	10.002016	11.017117	29
32	8.984189	2170	9.997972	22	8.986217	2191	11.013783	10.002028	11.015811	28
33	8.985491	2163	9.997959	20	8.987532	2184	11.012468	10.002041	11.014509	27
34	8.986789	2157	9.997947	20	8.988842	2178	11.011158	10.002053	11.013211	26
35	8.988083	2150	9.997935	22	8.990149	2171	11.009851	10.002065	11.011917	25
36	8.989374	2144	9.997922	20	8.991451	2165	11.008549	10.002078	11.010626	24
37	8.990660	2138	9.997910	22	8.992750	2158	11.007250	10.002090	11.009340	23
38	8.991943	2131	9.997897	20	8.994045	2152	11.005955	10.002103	11.008057	22
39	8.993222	2125	9.997885	22	8.995337	2146	11.004663	10.002115	11.006778	21
40	8.994497	2119	9.997872	20	8.996624	2140	11.003376	10.002128	11.005503	20
41	8.995768	2112	9.997860	22	8.997908	2134	11.002092	10.002140	11.004232	19
42	8.997036	2106	9.997847	20	8.999188	2127	11.000812	10.002153	11.002964	18
43	8.998299	2100	9.997835	22	9.000465	2121	10.999535	10.002165	11.001701	17
44	8.999560	2094	9.997822	22	9.001738	2115	10.998262	10.002178	11.000440	16
45	9.000816	2088	9.997809	20	9.003007	2109	10.996993	10.002191	10.999184	15
46	9.002069	2082	9.997797	22	9.004272	2103	10.995728	10.002203	10.997931	14
47	9.003318	2076	9.997784	22	9.005534	2097	10.994466	10.002216	10.996682	13
48	9.004563	2070	9.997771	22	9.006792	2091	10.993208	10.002229	10.995437	12
49	9.005805	2064	9.997758	22	9.008047	2085	10.991953	10.002242	10.994195	11
50	9.007044	2058	9.997745	22	9.009298	2079	10.990702	10.002255	10.992956	10
51	9.008278	2052	9.997732	22	9.010546	2074	10.989454	10.002268	10.991722	9
52	9.009510	2046	9.997719	22	9.011790	2068	10.988210	10.002281	10.990490	8
53	9.010737	2040	9.997706	22	9.013031	2062	10.986969	10.002294	10.989263	7
54	9.011962	2034	9.997693	22	9.014268	2056	10.985732	10.002307	10.988038	6
55	9.013182	2029	9.997680	22	9.015502	2051	10.984498	10.002320	10.986818	5
56	9.014400	2023	9.997667	22	9.016732	2045	10.983268	10.002333	10.985600	4
57	9.015613	2017	9.997654	22	9.017959	2039	10.982041	10.002346	10.984387	3
58	9.016824	2012	9.997641	22	9.019183	2034	10.980817	10.002359	10.983176	2
59	9.018031	2006	9.997628	23	9.020403	2028	10.979597	10.002372	10.981969	1
60	9.019235		9.997614		9.021620		10.978380	10.002386	10.980765	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

84 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

6 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.019235	2000	9.997614	22	9.021620	2023	10.978380	10.002386	10.980765	60
1	9.020435	1995	9.997601	22	9.022834	2017	10.977166	10.002399	10.979565	59
2	9.021632	1989	9.997588	23	9.024044	2011	10.975956	10.002412	10.978368	58
3	9.022825	1984	9.997574	22	9.025251	2006	10.974749	10.002426	10.977175	57
4	9.024016	1978	9.997561	23	9.026455	2001	10.973545	10.002439	10.975984	56
5	9.025203	1973	9.997547	22	9.027655	1995	10.972345	10.002453	10.974797	55
6	9.026386	1967	9.997534	23	9.028852	1990	10.971148	10.002466	10.973614	54
7	9.027567	1962	9.997520	22	9.030046	1985	10.969954	10.002480	10.972433	53
8	9.028744	1957	9.997507	23	9.031237	1979	10.968763	10.002493	10.971256	52
9	9.029918	1951	9.997493	22	9.032425	1974	10.967575	10.002507	10.970082	51
10	9.031089	1946	9.997480	23	9.033609	1969	10.966391	10.002520	10.968911	50
11	9.032257	1941	9.997466	23	9.034791	1964	10.965209	10.002534	10.967743	49
12	9.033421	1936	9.997452	22	9.035969	1958	10.964031	10.002548	10.966579	48
13	9.034582	1930	9.997439	23	9.037144	1953	10.962856	10.002561	10.965418	47
14	9.035741	1925	9.997425	23	9.038316	1948	10.961684	10.002575	10.964259	46
15	9.036896	1920	9.997411	23	9.039485	1943	10.960515	10.002589	10.963104	45
16	9.038048	1915	9.997397	23	9.040651	1938	10.959349	10.002603	10.961952	44
17	9.039197	1910	9.997383	23	9.041813	1933	10.958187	10.002617	10.960803	43
18	9.040342	1905	9.997369	23	9.042973	1928	10.957027	10.002631	10.959658	42
19	9.041485	1899	9.997355	23	9.044130	1923	10.955870	10.002645	10.958515	41
20	9.042625	1895	9.997341	23	9.045284	1918	10.954716	10.002659	10.957375	40
21	9.043762	1889	9.997327	23	9.046434	1913	10.953566	10.002673	10.956238	39
22	9.044895	1884	9.997313	23	9.047582	1908	10.952418	10.002687	10.955105	38
23	9.046026	1879	9.997299	23	9.048727	1903	10.951273	10.002701	10.953974	37
24	9.047154	1875	9.997285	23	9.049869	1898	10.950131	10.002715	10.952846	36
25	9.048279	1870	9.997271	23	9.051008	1893	10.948992	10.002729	10.951721	35
26	9.049400	1865	9.997257	25	9.052144	1889	10.947856	10.002743	10.950600	34
27	9.050519	1860	9.997242	23	9.053277	1884	10.946723	10.002756	10.949481	33
28	9.051635	1855	9.997228	23	9.054407	1879	10.945593	10.002772	10.948365	32
29	9.052749	1850	9.997214	25	9.055535	1874	10.944465	10.002786	10.947251	31
30	9.053859	1845	9.997199	23	9.056659	1870	10.943341	10.002801	10.946141	30
31	9.054966	1841	9.997185	25	9.057781	1865	10.942219	10.002815	10.945034	29
32	9.056071	1836	9.997170	23	9.058900	1860	10.941100	10.002830	10.943929	28
33	9.057172	1831	9.997156	25	9.060016	1855	10.939984	10.002844	10.942828	27
34	9.058271	1827	9.997141	23	9.061130	1851	10.938870	10.002859	10.941729	26
35	9.059367	1822	9.997127	25	9.062240	1846	10.937760	10.002873	10.940633	25
36	9.060460	1817	9.997112	23	9.063348	1842	10.936652	10.002888	10.939540	24
37	9.061551	1813	9.997098	25	9.064453	1837	10.935547	10.002902	10.938449	23
38	9.062639	1808	9.997083	25	9.065556	1833	10.934444	10.002917	10.937361	22
39	9.063724	1804	9.997068	25	9.066655	1828	10.933345	10.002932	10.936276	21
40	9.064806	1799	9.997053	23	9.067752	1824	10.932248	10.002947	10.935194	20
41	9.065885	1794	9.997039	25	9.068846	1819	10.931154	10.002961	10.934115	19
42	9.066962	1790	9.997024	25	9.069938	1815	10.930062	10.002976	10.933038	18
43	9.068036	1786	9.997009	25	9.071027	1810	10.928973	10.002991	10.931964	17
44	9.069107	1781	9.996994	25	9.072113	1806	10.927887	10.003006	10.930893	16
45	9.070176	1777	9.996979	25	9.073197	1802	10.926803	10.003021	10.929824	15
46	9.071242	1772	9.996964	25	9.074278	1797	10.925722	10.003036	10.928758	14
47	9.072306	1768	9.996949	25	9.075356	1793	10.924644	10.003051	10.927694	13
48	9.073366	1763	9.996934	25	9.076432	1789	10.923568	10.003066	10.926634	12
49	9.074424	1759	9.996919	25	9.077505	1784	10.922495	10.003081	10.925576	11
50	9.075480	1755	9.996904	25	9.078576	1780	10.921424	10.003096	10.924520	10
51	9.076533	1750	9.996889	25	9.079644	1776	10.920356	10.003111	10.923467	9
52	9.077583	1746	9.996874	27	9.080710	1772	10.919290	10.003126	10.922417	8
53	9.078631	1742	9.996858	25	9.081773	1767	10.918227	10.003142	10.921369	7
54	9.079676	1738	9.996843	25	9.082833	1763	10.917167	10.003157	10.920324	6
55	9.080719	1733	9.996828	27	9.083891	1759	10.916109	10.003172	10.919281	5
56	9.081759	1729	9.996812	25	9.084947	1755	10.915053	10.003188	10.918241	4
57	9.082797	1725	9.996797	25	9.086000	1751	10.914000	10.003203	10.917203	3
58	9.083832	1721	9.996782	27	9.087050	1747	10.912950	10.003218	10.916168	2
59	9.084864	1717	9.996766	25	9.088098	1743	10.911902	10.003234	10.915136	1
60	9.085894		9.996751		9.089144		10.910856	10.003249	10.914106	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

83 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

7 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.085894	1713	9.996751	27	9.089144	1738	10.910856	10.003249	10.914106	60
1	9.086922	1709	9.996735	25	9.090187	1735	10.909813	10.003265	10.913078	59
2	9.087947	1704	9.996720	27	9.091228	1731	10.908772	10.003280	10.912053	58
3	9.088970	1700	9.996704	27	9.092266	1727	10.907734	10.003296	10.911030	57
4	9.089990	1696	9.996688	25	9.093302	1722	10.906698	10.003312	10.910010	56
5	9.091008	1692	9.996673	27	9.094336	1719	10.905664	10.003327	10.908992	55
6	9.092024	1688	9.996657	27	9.095367	1715	10.904633	10.003343	10.907976	54
7	9.093037	1684	9.996641	27	9.096395	1711	10.903605	10.003359	10.906963	53
8	9.094047	1680	9.996625	25	9.097422	1707	10.902578	10.003375	10.905953	52
9	9.095056	1676	9.996610	27	9.098446	1703	10.901554	10.003390	10.904944	51
10	9.096062	1673	9.996594	27	9.099468	1699	10.900532	10.003406	10.903938	50
11	9.097065	1668	9.996578	27	9.100487	1695	10.899513	10.003422	10.902935	49
12	9.098066	1665	9.996562	27	9.101504	1691	10.898496	10.003438	10.901934	48
13	9.099065	1661	9.996546	27	9.102519	1687	10.897481	10.003454	10.900935	47
14	9.100062	1657	9.996530	27	9.103532	1684	10.896468	10.003470	10.899938	46
15	9.101056	1653	9.996514	27	9.104542	1680	10.895458	10.003486	10.898944	45
16	9.102048	1649	9.996498	27	9.105550	1676	10.894450	10.003502	10.897952	44
17	9.103037	1645	9.996482	28	9.106556	1672	10.893444	10.003518	10.896963	43
18	9.104025	1642	9.996465	27	9.107559	1669	10.892441	10.003535	10.895975	42
19	9.105010	1638	9.996449	27	9.108560	1665	10.891440	10.003551	10.894990	41
20	9.105992	1634	9.996433	27	9.109559	1661	10.890441	10.003567	10.894008	40
21	9.106973	1630	9.996417	28	9.110556	1658	10.889444	10.003583	10.893027	39
22	9.107951	1627	9.996400	27	9.111551	1654	10.888449	10.003600	10.892049	38
23	9.108927	1623	9.996384	27	9.112543	1650	10.887457	10.003616	10.891073	37
24	9.109901	1619	9.996368	28	9.113533	1647	10.886467	10.003632	10.890099	36
25	9.110873	1616	9.996351	27	9.114521	1643	10.885479	10.003649	10.889127	35
26	9.111842	1612	9.996335	28	9.115507	1639	10.884493	10.003665	10.888158	34
27	9.112809	1608	9.996318	27	9.116491	1636	10.883509	10.003682	10.887191	33
28	9.113774	1605	9.996302	28	9.117472	1632	10.882528	10.003698	10.886226	32
29	9.114737	1601	9.996285	27	9.118452	1629	10.881548	10.003715	10.885263	31
30	9.115698	1597	9.996269	28	9.119429	1625	10.880571	10.003731	10.884302	30
31	9.116656	1594	9.996252	28	9.120404	1622	10.879596	10.003748	10.883344	29
32	9.117613	1590	9.996235	27	9.121377	1618	10.878623	10.003765	10.882387	28
33	9.118567	1587	9.996219	28	9.122348	1615	10.877652	10.003781	10.881433	27
34	9.119519	1583	9.996202	28	9.123317	1611	10.876683	10.003798	10.880481	26
35	9.120469	1580	9.996185	28	9.124284	1608	10.875716	10.003815	10.879531	25
36	9.121417	1576	9.996168	28	9.125249	1604	10.874751	10.003832	10.878583	24
37	9.122362	1573	9.996151	28	9.126211	1601	10.873789	10.003849	10.877638	23
38	9.123306	1569	9.996134	28	9.127172	1597	10.872828	10.003866	10.876694	22
39	9.124248	1566	9.996117	28	9.128130	1594	10.871870	10.003883	10.875752	21
40	9.125187	1562	9.996100	28	9.129087	1591	10.870913	10.003900	10.874813	20
41	9.126125	1559	9.996083	28	9.130041	1587	10.869959	10.003917	10.873875	19
42	9.127060	1556	9.996066	28	9.130994	1584	10.869006	10.003934	10.872940	18
43	9.127993	1552	9.996049	28	9.131944	1581	10.868056	10.003951	10.872007	17
44	9.128925	1549	9.996032	28	9.132893	1577	10.867107	10.003968	10.871075	16
45	9.129854	1545	9.996015	28	9.133839	1574	10.866161	10.003985	10.870146	15
46	9.130781	1542	9.995998	30	9.134784	1571	10.865216	10.004002	10.869219	14
47	9.131706	1539	9.995980	28	9.135726	1567	10.864274	10.004020	10.868294	13
48	9.132630	1535	9.995963	28	9.136667	1564	10.863333	10.004037	10.867370	12
49	9.133551	1532	9.995946	30	9.137605	1561	10.862395	10.004054	10.866449	11
50	9.134470	1529	9.995928	28	9.138542	1558	10.861458	10.004072	10.865530	10
51	9.135387	1525	9.995911	28	9.139476	1555	10.860524	10.004089	10.864613	9
52	9.136303	1522	9.995894	30	9.140409	1551	10.859591	10.004106	10.863697	8
53	9.137216	1519	9.995876	28	9.141340	1548	10.858660	10.004124	10.862784	7
54	9.138128	1516	9.995859	30	9.142269	1545	10.857731	10.004141	10.861872	6
55	9.139037	1512	9.995841	30	9.143196	1542	10.856804	10.004159	10.860963	5
56	9.139944	1509	9.995823	28	9.144121	1539	10.855879	10.004177	10.860056	4
57	9.140850	1506	9.995806	30	9.145044	1535	10.854956	10.004194	10.859150	3
58	9.141754	1503	9.995788	28	9.145966	1532	10.854034	10.004212	10.858246	2
59	9.142655	1500	9.995771	30	9.146885	1529	10.853115	10.004229	10.857345	1
60	9.143555		9.995753		9.147803		10.852197	10.004247	10.856445	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

82 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

8 Degrees.

M	Sine.	Diff.	Co-sine	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M.
0	9.143555	1496	9.995753	30	9.147803	1526	10.852197	10.004247	10.856445	60
1	9.144453	1493	9.995735	30	9.148718	1523	10.851282	10.004265	10.855547	59
2	9.145349	1490	9.995717	30	9.149632	1520	10.850368	10.004283	10.854651	58
3	9.146243	1487	9.995699	30	9.150544	1517	10.849456	10.004301	10.853757	57
4	9.147136	1484	9.995681	28	9.151454	1514	10.848546	10.004319	10.852864	56
5	9.148026	1481	9.995664	30	9.152363	1511	10.847637	10.004336	10.851974	55
6	9.148915	1478	9.995646	30	9.153269	1508	10.846731	10.004354	10.851085	54
7	9.149802	1475	9.995628	30	9.154174	1505	10.845826	10.004372	10.850198	53
8	9.150686	1472	9.995610	32	9.155077	1502	10.844923	10.004390	10.849314	52
9	9.151569	1469	9.995591	30	9.155978	1499	10.844022	10.004409	10.848431	51
10	9.152451	1466	9.995573	30	9.156877	1496	10.843123	10.004427	10.847549	50
11	9.153330	1462	9.995555	30	9.157775	1493	10.842225	10.004445	10.846670	49
12	9.154208	1460	9.995537	30	9.158671	1490	10.841329	10.004463	10.845792	48
13	9.155083	1457	9.995519	30	9.159565	1487	10.840435	10.004481	10.844917	47
14	9.155957	1454	9.995501	32	9.160457	1484	10.839543	10.004499	10.844043	46
15	9.156830	1451	9.995482	30	9.161347	1481	10.838653	10.004518	10.843170	45
16	9.157700	1448	9.995464	30	9.162236	1478	10.837764	10.004536	10.842300	44
17	9.158569	1445	9.995446	32	9.163123	1475	10.836877	10.004554	10.841431	43
18	9.159435	1442	9.995427	30	9.164008	1473	10.835992	10.004573	10.840565	42
19	9.160301	1439	9.995409	32	9.164892	1470	10.835108	10.004591	10.839699	41
20	9.161164	1436	9.995390	30	9.165774	1467	10.834226	10.004610	10.838836	40
21	9.162025	1433	9.995372	32	9.166654	1464	10.833346	10.004628	10.837975	39
22	9.162885	1430	9.995353	32	9.167532	1461	10.832468	10.004647	10.837115	38
23	9.163743	1427	9.995334	30	9.168409	1458	10.831591	10.004666	10.836257	37
24	9.164600	1424	9.995316	32	9.169284	1455	10.830716	10.004684	10.835400	36
25	9.165454	1422	9.995297	32	9.170157	1453	10.829843	10.004703	10.834546	35
26	9.166307	1419	9.995278	30	9.171029	1450	10.828971	10.004722	10.833693	34
27	9.167159	1416	9.995260	32	9.171899	1447	10.828101	10.004740	10.832841	33
28	9.168008	1413	9.995241	32	9.172767	1444	10.827233	10.004759	10.831992	32
29	9.168856	1410	9.995222	32	9.173634	1442	10.826366	10.004778	10.831144	31
30	9.169702	1407	9.995203	32	9.174499	1439	10.825501	10.004797	10.830298	30
31	9.170547	1405	9.995184	32	9.175362	1436	10.824638	10.004816	10.829453	29
32	9.171389	1402	9.995165	32	9.176224	1433	10.823776	10.004835	10.828611	28
33	9.172230	1399	9.995146	32	9.177084	1431	10.822916	10.004854	10.827770	27
34	9.173070	1396	9.995127	32	9.177942	1428	10.822058	10.004873	10.826930	26
35	9.173908	1394	9.995108	32	9.178799	1425	10.821201	10.004892	10.826092	25
36	9.174744	1391	9.995089	32	9.179655	1423	10.820345	10.004911	10.825256	24
37	9.175578	1388	9.995070	32	9.180508	1420	10.819492	10.004930	10.824422	23
38	9.176411	1385	9.995051	32	9.181360	1417	10.818640	10.004949	10.823589	22
39	9.177242	1383	9.995032	32	9.182211	1415	10.817789	10.004968	10.822758	21
40	9.178072	1380	9.995013	33	9.183059	1412	10.816941	10.004987	10.821928	20
41	9.178900	1377	9.994993	32	9.183907	1409	10.816093	10.005007	10.821100	19
42	9.179726	1374	9.994974	32	9.184752	1407	10.815248	10.005026	10.820274	18
43	9.180551	1372	9.994955	33	9.185597	1404	10.814403	10.005045	10.819449	17
44	9.181374	1369	9.994935	32	9.186439	1402	10.813561	10.005065	10.818626	16
45	9.182196	1367	9.994916	33	9.187280	1399	10.812720	10.005084	10.817804	15
46	9.183016	1364	9.994896	32	9.188120	1396	10.811880	10.005104	10.816984	14
47	9.183834	1361	9.994877	33	9.188958	1394	10.811042	10.005123	10.816166	13
48	9.184651	1359	9.994857	32	9.189794	1391	10.810206	10.005143	10.815349	12
49	9.185466	1356	9.994838	33	9.190629	1389	10.809371	10.005162	10.814534	11
50	9.186280	1353	9.994818	33	9.191462	1386	10.808538	10.005182	10.813720	10
51	9.187092	1351	9.994798	32	9.192294	1384	10.807706	10.005202	10.812908	9
52	9.187903	1348	9.994779	33	9.193124	1381	10.806876	10.005221	10.812097	8
53	9.188712	1346	9.994759	33	9.193953	1379	10.806047	10.005241	10.811288	7
54	9.189519	1343	9.994739	32	9.194780	1376	10.805220	10.005261	10.810481	6
55	9.190325	1341	9.994720	33	9.195606	1374	10.804394	10.005281	10.809675	5
56	9.191130	1338	9.994700	33	9.196430	1371	10.803570	10.005300	10.808870	4
57	9.191933	1336	9.994680	33	9.197253	1369	10.802747	10.005320	10.808067	3
58	9.192734	1333	9.994660	33	9.198074	1366	10.801926	10.005340	10.807266	2
59	9.193534	1330	9.994640	33	9.198894	1364	10.801106	10.005360	10.806466	1
60	9.194332		9.994620		9.199713		10.800287	10.005380	10.805668	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

81 Degrees.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

9 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.194332	1328	9.994620	33	9.199713	1361	10.800287	10.005380	10.805668	60
1	9.195129	1326	9.994600	33	9.200529	1359	10.799471	10.005400	10.804871	59
2	9.195925	1323	9.994580	33	9.201345	1356	10.798655	10.005420	10.804075	58
3	9.196719	1321	9.994560	33	9.202159	1354	10.797841	10.005440	10.803281	57
4	9.197511	1318	9.994540	35	9.202971	1352	10.797029	10.005460	10.802489	56
5	9.198302	1316	9.994519	33	9.203782	1349	10.796218	10.005481	10.801698	55
6	9.199091	1313	9.994499	33	9.204592	1347	10.795408	10.005501	10.800909	54
7	9.199879	1311	9.994479	33	9.205400	1345	10.794600	10.005521	10.800121	53
8	9.200666	1308	9.994459	35	9.206207	1342	10.793793	10.005541	10.799334	52
9	9.201451	1306	9.994438	33	9.207013	1340	10.792987	10.005562	10.798549	51
10	9.202234	1304	9.994418	33	9.207817	1338	10.792183	10.005582	10.797766	50
11	9.203017	1301	9.994398	35	9.208619	1335	10.791381	10.005602	10.796983	49
12	9.203797	1299	9.994377	33	9.209420	1333	10.790580	10.005623	10.796203	48
13	9.204577	1296	9.994357	35	9.210220	1331	10.789780	10.005643	10.795423	47
14	9.205354	1294	9.994336	33	9.211018	1328	10.788982	10.005664	10.794646	46
15	9.206131	1292	9.994316	35	9.211815	1326	10.788185	10.005684	10.793869	45
16	9.206906	1289	9.994295	35	9.212611	1324	10.787389	10.005705	10.793094	44
17	9.207679	1287	9.994274	33	9.213405	1321	10.786595	10.005726	10.792321	43
18	9.208452	1285	9.994254	35	9.214198	1319	10.785802	10.005746	10.791548	42
19	9.209222	1282	9.994233	35	9.214989	1317	10.785011	10.005767	10.790778	41
20	9.209992	1280	9.994212	35	9.215780	1315	10.784220	10.005788	10.790008	40
21	9.210760	1278	9.994191	33	9.216568	1312	10.783432	10.005809	10.789240	39
22	9.211526	1275	9.994171	35	9.217356	1310	10.782644	10.005829	10.788474	38
23	9.212291	1273	9.994150	35	9.218142	1308	10.781858	10.005850	10.787709	37
24	9.213055	1271	9.994129	35	9.218926	1305	10.781074	10.005871	10.786945	36
25	9.213818	1268	9.994108	35	9.219710	1303	10.780290	10.005892	10.786182	35
26	9.214579	1266	9.994087	35	9.220492	1301	10.779508	10.005913	10.785421	34
27	9.215338	1264	9.994066	35	9.221272	1299	10.778728	10.005934	10.784662	33
28	9.216097	1261	9.994045	35	9.222052	1297	10.777948	10.005955	10.783903	32
29	9.216854	1259	9.994024	35	9.222830	1294	10.777170	10.005976	10.783146	31
30	9.217609	1257	9.994003	35	9.223607	1292	10.776393	10.005997	10.782391	30
31	9.218363	1255	9.993982	37	9.224382	1290	10.775618	10.006018	10.781637	29
32	9.219116	1253	9.993960	35	9.225156	1288	10.774844	10.006040	10.780884	28
33	9.219868	1250	9.993939	35	9.225929	1286	10.774071	10.006061	10.780132	27
34	9.220618	1248	9.993918	35	9.226700	1284	10.773300	10.006082	10.779382	26
35	9.221367	1246	9.993897	37	9.227471	1281	10.772529	10.006103	10.778633	25
36	9.222115	1244	9.993875	35	9.228239	1279	10.771761	10.006125	10.777885	24
37	9.222861	1242	9.993854	37	9.229007	1277	10.770993	10.006146	10.777139	23
38	9.223606	1239	9.993832	35	9.229773	1275	10.770227	10.006168	10.776394	22
39	9.224349	1237	9.993811	37	9.230539	1273	10.769461	10.006189	10.775651	21
40	9.225092	1235	9.993789	35	9.231302	1271	10.768698	10.006211	10.774908	20
41	9.225833	1233	9.993768	37	9.232065	1269	10.767935	10.006232	10.774167	19
42	9.226573	1231	9.993746	35	9.232826	1267	10.767174	10.006254	10.773427	18
43	9.227311	1228	9.993725	37	9.233586	1265	10.766414	10.006275	10.772689	17
44	9.228048	1226	9.993703	37	9.234345	1262	10.765655	10.006297	10.771952	16
45	9.228784	1224	9.993681	35	9.235103	1260	10.764897	10.006319	10.771216	15
46	9.229518	1222	9.993660	37	9.235859	1258	10.764141	10.006340	10.770482	14
47	9.230252	1220	9.993638	37	9.236614	1256	10.763386	10.006362	10.769748	13
48	9.230984	1218	9.993616	37	9.237368	1254	10.762632	10.006384	10.769016	12
49	9.231715	1216	9.993594	37	9.238120	1252	10.761880	10.006406	10.768285	11
50	9.232444	1214	9.993572	37	9.238872	1250	10.761128	10.006428	10.767556	10
51	9.233172	1212	9.993550	37	9.239622	1248	10.760378	10.006450	10.766828	9
52	9.233899	1209	9.993528	37	9.240371	1246	10.759629	10.006472	10.766101	8
53	9.234625	1207	9.993506	37	9.241118	1244	10.758882	10.006494	10.765375	7
54	9.235349	1205	9.993484	37	9.241865	1242	10.758135	10.006516	10.764651	6
55	9.236073	1203	9.993462	37	9.242610	1240	10.757390	10.006538	10.763927	5
56	9.236795	1201	9.993440	37	9.243354	1238	10.756646	10.006560	10.763205	4
57	9.237515	1199	9.993418	37	9.244097	1236	10.755903	10.006582	10.762485	3
58	9.238235	1197	9.993396	37	9.244839	1234	10.755161	10.006604	10.761765	2
59	9.238953	1195	9.993374	38	9.245579	1232	10.754421	10.006626	10.761047	1
60	9.239670		9.993351		9.246319		10.753681	10.006649	10.760330	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

80 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

10 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.239670	1193	9.993351	37	9.246319	1230	10.753681	10.006649	10.760330	60
1	9.240386	1191	9.993329	37	9.247057	1228	10.752943	10.006671	10.759614	59
2	9.241101	1189	9.993307	38	9.247794	1226	10.752206	10.006693	10.758899	58
3	9.241814	1187	9.993285	37	9.248530	1224	10.751470	10.006715	10.758186	57
4	9.242526	1185	9.993262	37	9.249264	1222	10.750736	10.006738	10.757474	56
5	9.243237	1183	9.993240	38	9.249998	1220	10.750002	10.006760	10.756763	55
6	9.243947	1181	9.993217	37	9.250730	1218	10.749270	10.006783	10.756053	54
7	9.244656	1179	9.993195	38	9.251461	1217	10.748539	10.006805	10.755344	53
8	9.245363	1177	9.993172	38	9.252191	1215	10.747809	10.006828	10.754637	52
9	9.246069	1175	9.993149	37	9.252920	1213	10.747080	10.006851	10.753931	51
10	9.246775	1173	9.993127	38	9.253648	1211	10.746352	10.006873	10.753225	50
11	9.247478	1171	9.993104	38	9.254374	1209	10.745626	10.006896	10.752522	49
12	9.248181	1169	9.993081	37	9.255100	1207	10.744900	10.006919	10.751819	48
13	9.248883	1167	9.993059	38	9.255824	1205	10.744176	10.006941	10.751117	47
14	9.249583	1165	9.993036	38	9.256547	1203	10.743453	10.006964	10.750117	46
15	9.250282	1163	9.993013	38	9.257269	1201	10.742731	10.006987	10.749718	45
16	9.250989	1161	9.992990	38	9.257990	1200	10.742010	10.007010	10.749020	44
17	9.251677	1159	9.992967	38	9.258710	1198	10.741290	10.007033	10.748323	43
18	9.252373	1158	9.992914	38	9.259429	1196	10.740571	10.007056	10.747627	42
19	9.253067	1156	9.992921	38	9.269146	1194	10.739854	10.007079	10.746933	41
20	9.253761	1154	9.992898	38	9.260863	1192	10.739137	10.007102	10.746239	40
21	9.254453	1152	9.992875	38	9.261578	1190	10.738422	10.007125	10.745547	39
22	9.255144	1150	9.992852	38	9.262292	1189	10.737708	10.007148	10.744856	38
23	9.255834	1148	9.992829	38	9.263095	1187	10.736995	10.007171	10.744166	37
24	9.256523	1146	9.992806	38	9.263717	1185	10.736283	10.007194	10.743477	36
25	9.257211	1144	9.992783	40	9.264428	1183	10.735572	10.007217	10.742789	35
26	9.257898	1142	9.992759	38	9.265135	1181	10.734862	10.007241	10.742102	34
27	9.258583	1141	9.992736	38	9.265847	1179	10.734153	10.007264	10.741417	33
28	9.259268	1139	9.992713	38	9.266555	1178	10.733445	10.007287	10.740732	32
29	9.259951	1137	9.992690	40	9.267261	1176	10.732739	10.007311	10.740049	31
30	9.260633	1135	9.992666	38	9.267967	1174	10.732033	10.007334	10.739367	30
31	9.261314	1133	9.992643	40	9.268671	1172	10.731329	10.007357	10.738686	29
32	9.261994	1131	9.992619	38	9.269375	1170	10.730625	10.007381	10.738006	28
33	9.262673	1130	9.992596	40	9.270077	1169	10.729923	10.007404	10.737327	27
34	9.263351	1128	9.992572	38	9.270779	1167	10.729221	10.007428	10.736649	26
35	9.264027	1126	9.992549	40	9.271479	1165	10.728521	10.007451	10.735973	25
36	9.264703	1124	9.992525	40	9.272178	1164	10.727822	10.007475	10.735297	24
37	9.265377	1122	9.992501	38	9.272876	1162	10.727124	10.007499	10.734623	23
38	9.266051	1120	9.992478	40	9.273573	1160	10.726427	10.007522	10.733949	22
39	9.266723	1119	9.992454	40	9.274269	1158	10.725731	10.007546	10.733277	21
40	9.267395	1117	9.992430	40	9.274964	1157	10.725036	10.007570	10.732605	20
41	9.268065	1115	9.992406	40	9.275658	1155	10.724342	10.007594	10.731935	19
42	9.268734	1113	9.992382	38	9.276351	1153	10.723649	10.007618	10.731266	18
43	9.269402	1111	9.992358	40	9.277043	1151	10.722957	10.007642	10.730598	17
44	9.270069	1110	9.992335	40	9.277734	1150	10.722266	10.007665	10.729931	16
45	9.270735	1108	9.992311	40	9.278424	1148	10.721576	10.007689	10.729265	15
46	9.271400	1106	9.992287	40	9.279113	1146	10.720887	10.007713	10.728600	14
47	9.272064	1105	9.992263	40	9.279801	1145	10.720199	10.007737	10.727936	13
48	9.272726	1103	9.992239	42	9.280488	1143	10.719512	10.007761	10.727274	12
49	9.273388	1101	9.992214	40	9.281174	1141	10.718826	10.007786	10.726612	11
50	9.274049	1099	9.992190	40	9.281858	1140	10.718142	10.007810	10.725951	10
51	9.274708	1098	9.992166	40	9.282542	1138	10.717458	10.007834	10.725292	9
52	9.275367	1096	9.992142	40	9.283225	1136	10.716775	10.007858	10.724633	8
53	9.276025	1094	9.992118	42	9.283907	1135	10.716093	10.007882	10.723975	7
54	9.276681	1092	9.992093	40	9.284588	1133	10.715412	10.007907	10.723319	6
55	9.277337	1091	9.992069	42	9.285268	1131	10.714732	10.007931	10.722663	5
56	9.277991	1089	9.992044	40	9.285947	1130	10.714053	10.007956	10.722009	4
57	9.278645	1087	9.992020	40	9.286624	1128	10.713376	10.007980	10.721355	3
58	9.279297	1086	9.991996	42	9.287301	1126	10.712699	10.008004	10.720703	2
59	9.279948	1084	9.991971	40	9.287977	1125	10.712023	10.008029	10.720052	1
60	9.280599		9.991947		9.288652		10.711348	10.008053	10.719401	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

79 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

11 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.280599	1682	9.991947	42	9.288652	1123	10.711348	10.008053	10.719401	60
1	9.281248	1081	9.991922	42	9.289326	1122	10.710674	10.008078	10.718752	59
2	9.281897	1079	9.991897	40	9.289999	1120	10.710001	10.008103	10.718103	58
3	9.282544	1077	9.991873	42	9.290671	1118	10.709329	10.008127	10.717456	57
4	9.283190	1076	9.991848	42	9.291342	1117	10.708658	10.008152	10.716810	56
5	9.283836	1074	9.991823	40	9.292013	1115	10.707987	10.008177	10.716164	55
6	9.284480	1072	9.991799	42	9.292682	1114	10.707318	10.008201	10.715520	54
7	9.285124	1071	9.991774	42	9.293350	1112	10.706650	10.008226	10.714876	53
8	9.285766	1069	9.991749	42	9.294017	1111	10.705983	10.008251	10.714234	52
9	9.286408	1067	9.991724	42	9.294684	1109	10.705316	10.008276	10.713592	51
10	9.287048	1066	9.991699	42	9.295349	1107	10.704651	10.008301	10.712952	50
11	9.287688	1064	9.991674	42	9.296013	1106	10.703987	10.008326	10.712312	49
12	9.288326	1063	9.991649	42	9.296677	1104	10.703323	10.008351	10.711674	48
13	9.288964	1061	9.991624	42	9.297339	1103	10.702661	10.008376	10.711036	47
14	9.289600	1059	9.991599	42	9.298001	1101	10.701999	10.008401	10.710400	46
15	9.290236	1058	9.991574	42	9.298662	1100	10.701338	10.008426	10.709764	45
16	9.290870	1056	9.991549	42	9.299322	1098	10.700678	10.008451	10.709130	44
17	9.291504	1054	9.991524	43	9.299980	1096	10.700020	10.008476	10.708496	43
18	9.292137	1053	9.991498	42	9.300638	1095	10.699362	10.008502	10.707863	42
19	9.292768	1051	9.991473	42	9.301295	1093	10.698705	10.008527	10.707232	41
20	9.293399	1050	9.991448	43	9.301951	1092	10.698049	10.008552	10.706601	40
21	9.294029	1048	9.991422	42	9.302607	1090	10.697393	10.008578	10.705971	39
22	9.294658	1046	9.991397	42	9.303261	1089	10.696739	10.008603	10.705342	38
23	9.295286	1045	9.991372	43	9.303914	1087	10.696086	10.008628	10.704714	37
24	9.295913	1043	9.991346	42	9.304567	1086	10.695433	10.008654	10.704087	36
25	9.296539	1042	9.991321	43	9.305218	1084	10.694782	10.008679	10.703461	35
26	9.297161	1040	9.991295	42	9.305869	1083	10.694131	10.008705	10.702836	34
27	9.297788	1039	9.991270	43	9.306519	1081	10.693481	10.008730	10.702212	33
28	9.298412	1037	9.991244	43	9.307168	1080	10.692832	10.008756	10.701588	32
29	9.299034	1036	9.991218	42	9.307815	1078	10.692185	10.008782	10.700966	31
30	9.299655	1034	9.991193	43	9.308463	1077	10.691537	10.008807	10.700345	30
31	9.300276	1032	9.991167	43	9.309109	1075	10.690891	10.008833	10.699724	29
32	9.300895	1031	9.991141	43	9.309754	1074	10.690246	10.008859	10.699105	28
33	9.301514	1029	9.991115	42	9.310398	1073	10.689602	10.008885	10.698486	27
34	9.302132	1028	9.991090	43	9.311042	1071	10.688958	10.008910	10.697868	26
35	9.302748	1026	9.991064	43	9.311685	1070	10.688315	10.008936	10.697252	25
36	9.303364	1025	9.991038	43	9.312327	1068	10.687673	10.008962	10.696636	24
37	9.303979	1023	9.991012	43	9.312967	1067	10.687033	10.008988	10.696021	23
38	9.304593	1022	9.990986	43	9.313608	1065	10.686392	10.009014	10.695407	22
39	9.305207	1020	9.990960	43	9.314247	1064	10.685753	10.009040	10.694793	21
40	9.305819	1019	9.990934	43	9.314885	1062	10.685115	10.009066	10.694181	20
41	9.306430	1017	9.990908	43	9.315523	1061	10.684477	10.009092	10.693570	19
42	9.307041	1016	9.990882	45	9.316159	1060	10.683841	10.009118	10.692959	18
43	9.307650	1014	9.990855	43	9.316795	1058	10.683205	10.009145	10.692350	17
44	9.308259	1013	9.990829	43	9.317430	1057	10.682570	10.009171	10.691741	16
45	9.308867	1011	9.990803	43	9.318064	1055	10.681936	10.009197	10.691133	15
46	9.309474	1010	9.990777	45	9.318697	1054	10.681303	10.009223	10.690526	14
47	9.310080	1008	9.990750	43	9.319329	1053	10.680671	10.009250	10.689920	13
48	9.310685	1007	9.990724	45	9.319961	1051	10.680039	10.009276	10.689315	12
49	9.311289	1006	9.990697	43	9.320592	1050	10.679408	10.009303	10.688711	11
50	9.311893	1004	9.990671	43	9.321222	1048	10.678778	10.009329	10.688107	10
51	9.312495	1003	9.990645	45	9.321851	1047	10.678149	10.009355	10.687505	9
52	9.313097	1001	9.990618	45	9.322479	1045	10.677521	10.009382	10.686903	8
53	9.313698	1000	9.990591	43	9.323106	1044	10.676894	10.009409	10.686302	7
54	9.314297	998	9.990565	45	9.323733	1043	10.676267	10.009435	10.685703	6
55	9.314897	997	9.990538	45	9.324358	1041	10.675642	10.009462	10.685103	5
56	9.315495	996	9.990511	43	9.324983	1040	10.675017	10.009489	10.684505	4
57	9.316092	994	9.990485	45	9.325607	1039	10.674393	10.009515	10.683908	3
58	9.316689	993	9.990458	45	9.326231	1037	10.673769	10.009542	10.683311	2
59	9.317284	991	9.990431	45	9.326853	1036	10.673147	10.009569	10.682716	1
60	9.317879		9.990404		9.327475		10.672525	10.009596	10.682121	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

78 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

12 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.317879	990	9.990404	43	9.327474	1035	10.672526	10.009596	10.682121	60
1	9.318473	988	9.990378	45	9.328095	1033	10.671905	10.009622	10.681527	59
2	9.319066	987	9.990351	45	9.328715	1032	10.671285	10.009649	10.680934	58
3	9.319658	986	9.990324	45	9.329334	1030	10.670666	10.009676	10.680342	57
4	9.320249	984	9.990297	45	9.329953	1029	10.670047	10.009703	10.679751	56
5	9.320840	983	9.990270	45	9.330570	1028	10.669430	10.009730	10.679160	55
6	9.321430	982	9.990243	47	9.331187	1026	10.668813	10.009757	10.678570	54
7	9.322019	980	9.990215	45	9.331803	1025	10.668197	10.009785	10.677981	53
8	9.322607	979	9.990188	45	9.332418	1024	10.667582	10.009812	10.677393	52
9	9.323194	977	9.990161	45	9.333033	1023	10.666967	10.009839	10.676806	51
10	9.323780	976	9.990134	45	9.333646	1021	10.666354	10.009866	10.676220	50
11	9.324366	975	9.990107	47	9.334259	1020	10.665741	10.009893	10.675634	49
12	9.324950	973	9.990079	45	9.334871	1019	10.665129	10.009921	10.675050	48
13	9.325534	972	9.990052	45	9.335482	1017	10.664518	10.009948	10.674466	47
14	9.326117	970	9.990025	47	9.336093	1016	10.663907	10.009975	10.673883	46
15	9.326700	969	9.989997	45	9.336702	1015	10.663298	10.010003	10.673300	45
16	9.327281	968	9.989970	47	9.337311	1013	10.662689	10.010030	10.672719	44
17	9.327862	966	9.989942	45	9.337919	1012	10.662081	10.010058	10.672138	43
18	9.328442	965	9.989915	47	9.338527	1011	10.661473	10.010085	10.671558	42
19	9.329021	964	9.989887	45	9.339133	1010	10.660867	10.010113	10.670979	41
20	9.329599	962	9.989860	47	9.339739	1008	10.660261	10.010140	10.670401	40
21	9.330176	961	9.989832	47	9.340344	1007	10.659656	10.010168	10.669824	39
22	9.330753	960	9.989804	45	9.340948	1006	10.659052	10.010196	10.669247	38
23	9.331329	958	9.989777	47	9.341552	1004	10.658448	10.010223	10.668671	37
24	9.331903	957	9.989749	47	9.342155	1003	10.657845	10.010251	10.668097	36
25	9.332478	956	9.989721	47	9.342757	1002	10.657243	10.010279	10.667522	35
26	9.333051	954	9.989693	47	9.343358	1091	10.656642	10.010307	10.666949	34
27	9.333624	953	9.989665	47	9.343958	999	10.656042	10.010335	10.666376	33
28	9.334195	952	9.989637	45	9.344558	998	10.655442	10.010363	10.665805	32
29	9.334767	950	9.989610	47	9.345157	997	10.654843	10.010390	10.665233	31
30	9.335337	949	9.989582	48	9.345755	996	10.654245	10.010418	10.664663	30
31	9.335906	948	9.989553	47	9.346353	994	10.653647	10.010447	10.664094	29
32	9.336475	946	9.989525	47	9.346949	993	10.653051	10.010475	10.663525	28
33	9.337043	945	9.989497	47	9.347545	992	10.652455	10.010503	10.662957	27
34	9.337610	944	9.989469	47	9.348141	991	10.651859	10.010531	10.662390	26
35	9.338176	943	9.989441	47	9.348735	990	10.651265	10.010559	10.661824	25
36	9.338742	941	9.989413	47	9.349329	988	10.650671	10.010587	10.661258	24
37	9.339307	940	9.989385	48	9.349922	987	10.650078	10.010615	10.660693	23
38	9.339871	939	9.989356	47	9.350514	986	10.649486	10.010644	10.660129	22
39	9.340434	937	9.989328	47	9.351106	985	10.648894	10.010672	10.659566	21
40	9.340996	936	9.989300	48	9.351697	983	10.648303	10.010700	10.659004	20
41	9.341558	935	9.989271	47	9.352287	982	10.647713	10.010729	10.658442	19
42	9.342119	934	9.989243	48	9.352876	981	10.647124	10.010757	10.657881	18
43	9.342679	932	9.989214	47	9.353465	980	10.646535	10.010786	10.657321	17
44	9.343239	931	9.989186	48	9.354053	979	10.645947	10.010814	10.656761	16
45	9.343797	930	9.989157	48	9.354640	977	10.645360	10.010843	10.656203	15
46	9.344355	929	9.989128	47	9.355227	976	10.644773	10.010872	10.655645	14
47	9.344912	927	9.989100	48	9.355813	975	10.644187	10.010900	10.655088	13
48	9.345469	926	9.989071	48	9.356398	974	10.643602	10.010929	10.654531	12
49	9.346024	925	9.989042	47	9.356982	973	10.643018	10.010958	10.653976	11
50	9.346579	924	9.989014	48	9.357566	971	10.642434	10.010986	10.653421	10
51	9.347134	922	9.988985	48	9.358149	970	10.641851	10.011015	10.652866	9
52	9.347687	921	9.988956	48	9.358731	969	10.641269	10.011044	10.652313	8
53	9.348240	920	9.988927	48	9.359313	968	10.640687	10.011073	10.651760	7
54	9.348792	919	9.988898	48	9.359893	967	10.640107	10.011102	10.651208	6
55	9.349343	917	9.988869	48	9.360474	966	10.639526	10.011131	10.650657	5
56	9.349893	916	9.988840	48	9.361053	965	10.638947	10.011160	10.650107	4
57	9.350443	915	9.988811	48	9.361632	963	10.638368	10.011189	10.649557	3
58	9.350992	914	9.988782	48	9.362210	962	10.637790	10.011218	10.649008	2
59	9.351540	913	9.988753	48	9.362787	961	10.637213	10.011247	10.648460	1
60	9.352088		9.988724		9.363364		10.636636	10.011276	10.647912	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

77 Degrees.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

13 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.352088	911	9.988724	48	9.363364	960	10.636636	10.011276	10.647912	60
1	9.352635	910	9.988695	48	9.363940	959	10.636060	10.011305	10.647365	59
2	9.353181	909	9.988666	50	9.364515	958	10.635485	10.011334	10.646819	58
3	9.353726	908	9.988636	48	9.365090	957	10.634910	10.011364	10.646274	57
4	9.354271	907	9.988607	48	9.365664	955	10.634336	10.011393	10.645729	56
5	9.354815	905	9.988578	50	9.366237	954	10.633763	10.011422	10.645185	55
6	9.355358	904	9.988548	48	9.366810	953	10.633190	10.011452	10.644642	54
7	9.355901	903	9.988519	50	9.367382	952	10.632618	10.011481	10.644099	53
8	9.356143	902	9.988489	48	9.367953	951	10.632047	10.011511	10.643557	52
9	9.356984	901	9.988460	50	9.368524	950	10.631476	10.011540	10.643016	51
10	9.357524	899	9.988430	48	9.369094	949	10.630906	10.011570	10.642476	50
11	9.358064	898	9.988401	50	9.369663	948	10.630337	10.011599	10.641936	49
12	9.358603	897	9.988371	48	9.370232	946	10.629768	10.011629	10.641397	48
13	9.359141	896	9.988342	50	9.370799	945	10.629201	10.011658	10.640859	47
14	9.359678	895	9.988312	50	9.371367	944	10.628633	10.011688	10.640322	46
15	9.360215	893	9.988282	50	9.371933	943	10.628067	10.011718	10.639785	45
16	9.360752	892	9.988252	48	9.372499	942	10.627501	10.011748	10.639248	44
17	9.361287	891	9.988223	50	9.373064	941	10.626936	10.011777	10.638713	43
18	9.361822	890	9.988193	50	9.373629	940	10.626371	10.011807	10.638178	42
19	9.362356	889	9.988163	50	9.374193	939	10.625807	10.011837	10.637644	41
20	9.362889	888	9.988133	50	9.374756	938	10.625244	10.011867	10.637111	40
21	9.363422	887	9.988103	50	9.375319	937	10.624681	10.011897	10.636578	39
22	9.363954	885	9.988073	50	9.375881	935	10.624119	10.011927	10.636046	38
23	9.364485	884	9.988043	50	9.376442	934	10.623558	10.011957	10.635515	37
24	9.365016	883	9.988013	50	9.377003	933	10.622997	10.011987	10.634984	36
25	9.365546	882	9.987983	50	9.377563	932	10.622437	10.012017	10.634454	35
26	9.366075	881	9.987953	52	9.378122	931	10.621878	10.012047	10.633925	34
27	9.366604	880	9.987922	50	9.378681	930	10.621319	10.012078	10.633396	33
28	9.367131	879	9.987892	50	9.379239	929	10.620761	10.012108	10.632869	32
29	9.367659	878	9.987862	50	9.379797	928	10.620203	10.012158	10.632341	31
30	9.368185	876	9.987832	52	9.380354	927	10.619646	10.012168	10.631815	30
31	9.368711	875	9.987801	50	9.380910	926	10.619090	10.012199	10.631289	29
32	9.369236	874	9.987771	52	9.381466	925	10.618534	10.012229	10.630764	28
33	9.369761	873	9.987740	50	9.382020	924	10.617980	10.012260	10.630239	27
34	9.370285	872	9.987710	52	9.382575	923	10.617425	10.012290	10.629715	26
35	9.370808	871	9.987679	50	9.383129	922	10.616871	10.012321	10.629192	25
36	9.371330	870	9.987649	52	9.383682	921	10.616318	10.012351	10.628670	24
37	9.371852	869	9.987618	50	9.384234	920	10.615766	10.012382	10.628148	23
38	9.372373	867	9.987588	52	9.384786	919	10.615214	10.012412	10.627627	22
39	9.372894	866	9.987557	52	9.385337	918	10.614663	10.012443	10.627106	21
40	9.373414	865	9.987526	50	9.385888	917	10.614112	10.012474	10.626586	20
41	9.373933	864	9.987496	52	9.386438	916	10.613562	10.012504	10.626067	19
42	9.374452	863	9.987465	52	9.386987	914	10.613013	10.012535	10.625548	18
43	9.374970	862	9.987434	52	9.387536	913	10.612464	10.012566	10.625030	17
44	9.375487	861	9.987403	52	9.388084	912	10.611916	10.012597	10.624513	16
45	9.376003	860	9.987372	52	9.388631	911	10.611369	10.012628	10.623997	15
46	9.376519	859	9.987341	52	9.389178	910	10.610822	10.012659	10.623481	14
47	9.377035	858	9.987310	52	9.389724	909	10.610276	10.012690	10.622965	13
48	9.377549	857	9.987279	52	9.390270	908	10.609730	10.012721	10.622451	12
49	9.378063	856	9.987248	52	9.390815	907	10.609185	10.012752	10.621937	11
50	9.378577	854	9.987217	52	9.391360	906	10.608640	10.012783	10.621423	10
51	9.379089	853	9.987186	52	9.391903	905	10.608097	10.012814	10.620911	9
52	9.379601	852	9.987155	52	9.392447	904	10.607553	10.012845	10.620399	8
53	9.380113	851	9.987124	53	9.392989	903	10.607011	10.012876	10.619887	7
54	9.380624	850	9.987092	52	9.393531	902	10.606469	10.012908	10.619376	6
55	9.381134	849	9.987061	52	9.394073	901	10.605927	10.012939	10.618866	5
56	9.381643	848	9.987030	53	9.394614	900	10.605386	10.012970	10.618357	4
57	9.382152	847	9.986998	52	9.395154	899	10.604846	10.013002	10.617848	3
58	9.382661	846	9.986967	52	9.395694	898	10.604306	10.013033	10.617339	2
59	9.383168	845	9.986936	53	9.396233	897	10.603767	10.013064	10.616832	1
60	9.383675		9.986904		9.396771		10.603229	10.013096	10.616325	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

76 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

14 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.383675	844	9.986904	52	9.396771	896	10.603229	10.013096	10.616325	60
1	9.384182	843	9.986873	53	9.397309	896	10.602691	10.013127	10.615818	59
2	9.384687	842	9.986841	53	9.397846	895	10.602154	10.013159	10.615313	58
3	9.385192	841	9.986809	52	9.398383	894	10.601617	10.013191	10.614808	57
4	9.385697	840	9.986778	53	9.398919	893	10.601081	10.013222	10.614303	56
5	9.386201	839	9.986746	53	9.399455	892	10.600545	10.013254	10.613799	55
6	9.386704	838	9.986714	52	9.399990	891	10.600010	10.013286	10.613296	54
7	9.387207	837	9.986683	53	9.400524	890	10.599476	10.013317	10.612793	53
8	9.387709	836	9.986651	53	9.401058	889	10.598942	10.013349	10.612291	52
9	9.388210	835	9.986619	53	9.401591	888	10.598409	10.013381	10.611790	51
10	9.388711	834	9.986587	53	9.402124	887	10.597876	10.013413	10.611289	50
11	9.389211	833	9.986555	53	9.402656	886	10.597344	10.013445	10.610789	49
12	9.389711	832	9.986523	53	9.403187	885	10.596813	10.013477	10.610289	48
13	9.390210	831	9.986491	53	9.403718	884	10.596282	10.013509	10.609790	47
14	9.390708	830	9.986459	53	9.404249	883	10.595751	10.013541	10.609292	46
15	9.391206	828	9.986427	53	9.404778	882	10.595222	10.013573	10.608794	45
16	9.391703	827	9.986395	53	9.405308	881	10.594692	10.013605	10.608297	44
17	9.392199	826	9.986363	53	9.405836	880	10.594164	10.013637	10.607801	43
18	9.392695	825	9.986331	53	9.406364	879	10.593636	10.013669	10.607305	42
19	9.393191	824	9.986299	55	9.406892	878	10.593108	10.013701	10.606810	41
20	9.393685	823	9.986266	53	9.407419	877	10.592581	10.013734	10.606315	40
21	9.394179	822	9.986234	53	9.407945	876	10.592055	10.013766	10.605821	39
22	9.394673	821	9.986202	55	9.408471	875	10.591529	10.013798	10.605327	38
23	9.395166	820	9.986169	53	9.408997	874	10.591003	10.013831	10.604834	37
24	9.395658	819	9.986137	55	9.409521	874	10.590479	10.013863	10.604342	36
25	9.396150	818	9.986104	53	9.410045	873	10.589955	10.013896	10.603850	35
26	9.396641	817	9.986072	55	9.410569	872	10.589431	10.013928	10.603359	34
27	9.397132	817	9.986039	53	9.411092	871	10.588908	10.013961	10.602868	33
28	9.397621	816	9.986007	55	9.411615	870	10.588385	10.013993	10.602379	32
29	9.398111	815	9.985974	53	9.412137	869	10.587863	10.014026	10.601889	31
30	9.398600	814	9.985942	55	9.412658	868	10.587342	10.014058	10.601400	30
31	9.399088	813	9.985909	55	9.413179	867	10.586821	10.014091	10.600912	29
32	9.399575	812	9.985876	55	9.413699	866	10.586301	10.014124	10.600425	28
33	9.400062	811	9.985843	53	9.414219	865	10.585781	10.014157	10.599938	27
34	9.400549	810	9.985811	55	9.414738	864	10.585262	10.014189	10.599451	26
35	9.401035	809	9.985778	55	9.415257	864	10.584743	10.014222	10.598965	25
36	9.401520	808	9.985745	55	9.415775	863	10.584225	10.014255	10.598480	24
37	9.402005	807	9.985712	55	9.416293	862	10.583707	10.014288	10.597995	23
38	9.402489	806	9.985679	55	9.416810	861	10.583190	10.014321	10.597511	22
39	9.402972	805	9.985646	55	9.417326	860	10.582674	10.014354	10.597028	21
40	9.403455	804	9.985613	55	9.417842	859	10.582158	10.014387	10.596545	20
41	9.403938	803	9.985580	55	9.418358	858	10.581642	10.014420	10.596062	19
42	9.404420	802	9.985547	55	9.418873	857	10.581127	10.014453	10.595580	18
43	9.404901	801	9.985514	57	9.419387	856	10.580613	10.014486	10.595099	17
44	9.405382	800	9.985480	55	9.419901	855	10.580099	10.014520	10.594618	16
45	9.405862	799	9.985447	55	9.420415	855	10.579585	10.014553	10.594138	15
46	9.406341	798	9.985414	55	9.420927	854	10.579073	10.014586	10.593659	14
47	9.406820	797	9.985381	57	9.421440	853	10.578560	10.014619	10.593180	13
48	9.407299	796	9.985347	55	9.421952	852	10.578048	10.014653	10.592701	12
49	9.407777	795	9.985314	57	9.422463	851	10.577537	10.014686	10.592223	11
50	9.408254	794	9.985280	55	9.422974	850	10.577026	10.014720	10.591746	10
51	9.408731	794	9.985247	57	9.423484	849	10.576516	10.014753	10.591269	9
52	9.409207	793	9.985213	55	9.423993	848	10.576007	10.014787	10.590793	8
53	9.409682	792	9.985180	57	9.424503	848	10.575497	10.014820	10.590318	7
54	9.410157	791	9.985146	55	9.425011	847	10.574989	10.014854	10.589843	6
55	9.410632	790	9.985113	57	9.425519	846	10.574481	10.014887	10.589368	5
56	9.411106	789	9.985079	57	9.426027	845	10.573973	10.014921	10.588894	4
57	9.411579	788	9.985045	57	9.426534	844	10.573466	10.014955	10.588421	3
58	9.412052	787	9.985011	55	9.427041	843	10.572959	10.014989	10.587948	2
59	9.412524	786	9.984978	57	9.427547	843	10.572453	10.015022	10.587476	1
60	9.412996		9.984944		9.428052		10.571948	10.015056	10.587004	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

75 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

15 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.412996	785	9.984944	57	9.428052	842	10.571948	10.015056	10.587004	60
1	9.413467	784	9.984910	57	9.428557	841	10.571443	10.015090	10.586533	59
2	9.413938	783	9.984876	57	9.429062	840	10.570938	10.015124	10.586062	58
3	9.414408	783	9.984842	57	9.429566	839	10.570434	10.015158	10.585592	57
4	9.414878	782	9.984808	57	9.430070	838	10.569930	10.015192	10.585122	56
5	9.415347	781	9.984774	57	9.430573	838	10.569427	10.015226	10.584653	55
6	9.415815	780	9.984740	57	9.431075	837	10.568925	10.015260	10.584185	54
7	9.416283	779	9.984706	57	9.431577	836	10.568423	10.015294	10.583717	53
8	9.416751	778	9.984672	57	9.432079	835	10.567921	10.015328	10.583249	52
9	9.417217	777	9.984638	58	9.432580	834	10.567420	10.015362	10.582783	51
10	9.417684	776	9.984603	57	9.433080	833	10.566920	10.015397	10.582316	50
11	9.418150	775	9.984569	57	9.433580	832	10.566420	10.015431	10.581850	49
12	9.418615	774	9.984535	58	9.434080	832	10.565920	10.015465	10.581385	48
13	9.419079	773	9.984500	57	9.434579	831	10.565421	10.015500	10.580921	47
14	9.419544	773	9.984466	57	9.435078	830	10.564922	10.015534	10.580456	46
15	9.420007	772	9.984432	58	9.435576	829	10.564424	10.015568	10.579993	45
16	9.420470	771	9.984397	57	9.436073	828	10.563927	10.015603	10.579530	44
17	9.420933	770	9.984363	58	9.436570	828	10.563430	10.015637	10.579067	43
18	9.421395	769	9.984328	58	9.437067	827	10.562933	10.015672	10.578605	42
19	9.421857	768	9.984294	57	9.437563	826	10.562437	10.015706	10.578143	41
20	9.422318	767	9.984259	58	9.438059	825	10.561941	10.015741	10.577682	40
21	9.422778	767	9.984224	57	9.438554	824	10.561446	10.015776	10.577222	39
22	9.423238	766	9.984190	58	9.439048	823	10.560952	10.015810	10.576762	38
23	9.423697	765	9.984155	58	9.439543	823	10.560457	10.015845	10.576303	37
24	9.424156	764	9.984120	58	9.440036	822	10.559964	10.015880	10.575844	36
25	9.424615	763	9.984085	58	9.440529	821	10.559471	10.015915	10.575385	35
26	9.425073	762	9.984050	58	9.441022	820	10.558978	10.015950	10.574927	34
27	9.425530	761	9.984015	57	9.441514	819	10.558486	10.015985	10.574470	33
28	9.425987	760	9.983981	58	9.442006	819	10.557994	10.016019	10.574013	32
29	9.426443	760	9.983946	58	9.442497	818	10.557503	10.016054	10.573557	31
30	9.426899	759	9.983911	60	9.442988	817	10.557012	10.016089	10.573101	30
31	9.427354	758	9.983875	58	9.443479	816	10.556521	10.016125	10.572646	29
32	9.427809	757	9.983840	58	9.443968	816	10.556032	10.016160	10.572191	28
33	9.428263	756	9.983805	58	9.444458	815	10.555542	10.016195	10.571737	27
34	9.428717	755	9.983770	58	9.444947	814	10.555053	10.016230	10.571283	26
35	9.429170	754	9.983735	58	9.445435	813	10.554565	10.016265	10.570830	25
36	9.429623	753	9.983700	60	9.445923	812	10.554077	10.016300	10.570377	24
37	9.430075	752	9.983664	58	9.446411	812	10.553589	10.016336	10.569925	23
38	9.430527	752	9.983629	58	9.446898	811	10.553102	10.016371	10.569473	22
39	9.430978	751	9.983594	60	9.447384	810	10.552616	10.016406	10.569022	21
40	9.431429	750	9.983558	58	9.447870	809	10.552130	10.016442	10.568571	20
41	9.431879	749	9.983523	60	9.448356	809	10.551644	10.016477	10.568121	19
42	9.432329	749	9.983487	58	9.448841	808	10.551159	10.016513	10.567671	18
43	9.432778	748	9.983452	60	9.449326	807	10.550674	10.016548	10.567222	17
44	9.433226	747	9.983416	58	9.449810	806	10.550190	10.016584	10.566774	16
45	9.433675	746	9.983381	60	9.450294	806	10.549706	10.016619	10.566325	15
46	9.434122	745	9.983345	60	9.450777	805	10.549223	10.016655	10.565878	14
47	9.434569	744	9.983309	60	9.451260	804	10.548740	10.016691	10.565431	13
48	9.435016	744	9.983273	58	9.451743	803	10.548257	10.016727	10.564984	12
49	9.435462	743	9.983238	60	9.452225	802	10.547775	10.016762	10.564538	11
50	9.435908	742	9.983202	60	9.452706	802	10.547294	10.016798	10.564092	10
51	9.436353	741	9.983166	60	9.453187	801	10.546813	10.016834	10.563647	9
52	9.436798	740	9.983130	60	9.453668	800	10.546332	10.016870	10.563202	8
53	9.437242	740	9.983094	60	9.454148	799	10.545852	10.016906	10.562758	7
54	9.437686	739	9.983058	60	9.454628	799	10.545372	10.016942	10.562314	6
55	9.438129	738	9.983022	60	9.455107	798	10.544893	10.016978	10.561871	5
56	9.438572	737	9.982986	60	9.455586	797	10.544414	10.017014	10.561428	4
57	9.439014	736	9.982950	60	9.456064	796	10.543936	10.017050	10.560986	3
58	9.439456	736	9.982914	60	9.456542	796	10.543458	10.017086	10.560544	2
59	9.439897	735	9.982878	60	9.457019	795	10.542981	10.017122	10.560103	1
60	9.440338		9.982842		9.457496		10.542504	10.017158	10.559662	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

74 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

16 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.440338	734	9.982842	62	9.457496	794	10.542504	10.017158	10.559662	60
1	9.440778	733	9.982805	60	9.457973	793	10.542027	10.017195	10.559222	59
2	9.441218	732	9.982769	60	9.458449	793	10.541551	10.017231	10.558782	58
3	9.441658	731	9.982733	62	9.458925	792	10.541075	10.017267	10.558342	57
4	9.442096	731	9.982696	60	9.459400	791	10.540600	10.017304	10.557904	56
5	9.442535	730	9.982660	60	9.459875	790	10.540125	10.017340	10.557465	55
6	9.442973	729	9.982624	62	9.460349	790	10.539651	10.017376	10.557027	54
7	9.443410	728	9.982587	60	9.460823	789	10.539177	10.017413	10.556590	53
8	9.443847	727	9.982551	62	9.461297	788	10.538703	10.017449	10.556153	52
9	9.444284	727	9.982514	62	9.461770	788	10.538230	10.017486	10.555716	51
10	9.444720	726	9.982477	60	9.462242	787	10.537758	10.017523	10.555280	50
11	9.445155	725	9.982441	62	9.462714	786	10.537286	10.017559	10.554845	49
12	9.445590	724	9.982404	62	9.463186	785	10.536814	10.017596	10.554410	48
13	9.446025	723	9.982367	60	9.463658	785	10.536342	10.017633	10.553975	47
14	9.446459	723	9.982331	62	9.464128	784	10.535872	10.017669	10.553541	46
15	9.446893	722	9.982294	62	9.464599	783	10.535401	10.017706	10.553107	45
16	9.447326	721	9.982257	62	9.465069	783	10.534931	10.017743	10.552674	44
17	9.447759	720	9.982220	62	9.465539	782	10.534461	10.017780	10.552241	43
18	9.448191	720	9.982183	62	9.466008	781	10.533992	10.017817	10.551809	42
19	9.448623	719	9.982146	62	9.466476	780	10.533524	10.017854	10.551377	41
20	9.449054	718	9.982109	62	9.466945	780	10.533055	10.017891	10.550946	40
21	9.449485	717	9.982072	62	9.467413	779	10.532587	10.017928	10.550515	39
22	9.449915	716	9.982035	62	9.467880	778	10.532120	10.017965	10.550085	38
23	9.450345	716	9.981998	62	9.468347	778	10.531653	10.018002	10.549655	37
24	9.450775	715	9.981961	62	9.468814	777	10.531186	10.018039	10.549225	36
25	9.451204	714	9.981924	63	9.469280	776	10.530720	10.018076	10.548796	35
26	9.451632	713	9.981886	62	9.469746	775	10.530254	10.018114	10.548368	34
27	9.452060	713	9.981849	62	9.470211	775	10.529789	10.018151	10.547940	33
28	9.452488	712	9.981812	63	9.470676	774	10.529324	10.018188	10.547512	32
29	9.452915	711	9.981774	62	9.471141	773	10.528859	10.018226	10.547085	31
30	9.453342	710	9.981737	62	9.471605	773	10.528395	10.018263	10.546658	30
31	9.453768	710	9.981700	63	9.472068	772	10.527932	10.018300	10.546232	29
32	9.454194	709	9.981662	62	9.472532	771	10.527468	10.018338	10.545806	28
33	9.454619	708	9.981625	63	9.472995	771	10.527005	10.018375	10.545381	27
34	9.455044	707	9.981587	63	9.473457	770	10.526543	10.018413	10.544956	26
35	9.455469	707	9.981549	62	9.473919	769	10.526081	10.018451	10.544531	25
36	9.455893	706	9.981512	63	9.474381	769	10.525619	10.018488	10.544107	24
37	9.456316	705	9.981474	63	9.474842	768	10.525158	10.018526	10.543684	23
38	9.456739	704	9.981436	62	9.475303	767	10.524697	10.018564	10.543261	22
39	9.457162	704	9.981399	63	9.475763	767	10.524237	10.018601	10.542838	21
40	9.457584	703	9.981361	63	9.476223	766	10.523777	10.018639	10.542416	20
41	9.458006	702	9.981323	63	9.476683	765	10.523317	10.018677	10.541994	19
42	9.458427	701	9.981285	63	9.477142	765	10.522858	10.018715	10.541573	18
43	9.458848	701	9.981247	63	9.477601	764	10.522399	10.018753	10.541152	17
44	9.459268	700	9.981209	63	9.478059	763	10.521941	10.018791	10.540732	16
45	9.459688	699	9.981171	63	9.478517	763	10.521483	10.018829	10.540312	15
46	9.460108	698	9.981133	63	9.478975	762	10.521025	10.018867	10.539892	14
47	9.460527	698	9.981095	63	9.479432	761	10.520568	10.018905	10.539473	13
48	9.460946	697	9.981057	63	9.479889	761	10.520111	10.018943	10.539054	12
49	9.461364	696	9.981019	63	9.480345	760	10.519655	10.018981	10.538636	11
50	9.461782	695	9.980981	65	9.480801	759	10.519199	10.019019	10.538218	10
51	9.462199	695	9.980942	63	9.481257	759	10.518743	10.019058	10.537801	9
52	9.462616	694	9.980904	63	9.481712	758	10.518288	10.019096	10.537384	8
53	9.463032	693	9.980866	65	9.482167	757	10.517833	10.019134	10.536968	7
54	9.463448	693	9.980827	63	9.482621	757	10.517379	10.019173	10.536552	6
55	9.463864	692	9.980789	65	9.483075	756	10.516925	10.019211	10.536136	5
56	9.464279	691	9.980750	63	9.483529	755	10.516471	10.019250	10.535721	4
57	9.464694	690	9.980712	65	9.483982	755	10.516018	10.019288	10.535306	3
58	9.465108	690	9.980673	63	9.484435	754	10.515565	10.019327	10.534802	2
59	9.465522	689	9.980635	65	9.484887	753	10.515113	10.019365	10.534478	1
60	9.465935		9.980596		9.485339		10.514661	10.019404	10.534065	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

73 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

17 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.465935	688	9.980596	63	9.485339	753	10.514661	10.019404	10.534065	60
1	9.466348	688	9.980558	65	9.485791	752	10.514209	10.019442	10.533652	59
2	9.466761	687	9.980519	65	9.486242	751	10.513758	10.019481	10.533239	58
3	9.467173	686	9.980480	63	9.486693	751	10.513307	10.019520	10.532827	57
4	9.467585	685	9.980442	65	9.487143	750	10.512857	10.019558	10.532415	56
5	9.467996	685	9.980403	65	9.487593	749	10.512407	10.019597	10.532004	55
6	9.468407	684	9.980364	65	9.488043	749	10.511957	10.019636	10.531593	54
7	9 468817	683	9.980325	65	9.488492	748	10.511508	10.019675	10.531183	53
8	9.469227	683	9.980286	65	9.488941	747	10.511059	10.019714	10.530773	52
9	9.469637	682	9.980247	65	9.489390	747	10.510610	10.019753	10.530363	51
10	9.470046	681	9.980208	65	9.489838	746	10.510162	10.019792	10.529954	50
11	9.470455	680	9.980169	65	9.490286	746	10.509714	10.019831	10.529545	49
12	9.470863	680	9.980130	65	9.490733	745	10.509267	10.019870	10.529137	48
13	9.471271	679	9.980091	65	9.491180	744	10.508820	10.019909	10.528729	47
14	9.471679	678	9.980052	67	9.491627	744	10.508373	10.019948	10.528321	46
15	9.472086	678	9.980012	65	9.492073	743	10.507927	10.019988	10.527914	45
16	9.472492	677	9.979973	65	9.492519	743	10.507481	10.020027	10.527508	44
17	9.472898	676	9.979934	65	9.492965	742	10.507035	10.020066	10.527102	43
18	9.473304	676	9.979895	67	9.493410	741	10.506590	10.020105	10.526696	42
19	9.473710	675	9.979855	65	9.493854	740	10.506146	10.020145	10.526290	41
20	9.474115	674	9.979816	67	9.494299	740	10.505701	10.020184	10.525885	40
21	9.474519	674	9.979776	65	9.494743	739	10.505257	10.020224	10.525481	39
22	9 474923	673	9.979737	67	9.495186	739	10.504814	10.020263	10.525077	38
23	9.475327	672	9.979697	65	9.495630	738	10.504370	10.020303	10.524673	37
24	9.475730	672	9.979658	67	9.496073	737	10.503927	10.020342	10.524270	36
25	9.476133	671	9.979618	65	9.496515	737	10.503485	10.020382	10.523867	35
26	9.476536	670	9.979579	67	9.496957	736	10.503043	10.020421	10.523464	34
27	9.476938	669	9.979539	67	9.497399	736	10.502601	10.020461	10.523062	33
28	9.477340	669	9.979499	67	9.497841	735	10.502159	10.020501	10.522660	32
29	9.477741	668	9.979459	65	9.498282	734	10.501718	10.020541	10.522259	31
30	9.478142	667	9.979420	67	9.498722	734	10.501278	10.020580	10.521858	30
31	9.478542	667	9.979380	67	9.499163	733	10.500837	10.020620	10.521458	29
32	9.478942	666	9.979340	67	9.499603	733	10.500397	10.020660	10.521058	28
33	9.479342	665	9.979300	67	9.500042	732	10.499958	10.020700	10.520658	27
34	9.479741	665	9.979260	67	9.500481	731	10.499519	10.020740	10.520259	26
35	9.480140	664	9.979220	67	9.500920	731	10.499080	10.020780	10.519860	25
36	9.480539	663	9.979180	67	9.501359	730	10.498641	10.020820	10.519461	24
37	9.480937	663	9.979140	67	9.501797	730	10.498203	10.020860	10.519063	23
38	9.481334	662	9.979100	68	9.502235	729	10.497765	10.020900	10.518666	22
39	9.481731	661	9.979059	67	9.502672	728	10.497328	10.020941	10.518269	21
40	9.482128	661	9.979019	67	9.503109	728	10.496891	10.020981	10.517872	20
41	9.482525	660	9.978979	67	9.503546	727	10.496454	10.021021	10.517475	19
42	9.482921	659	9.978939	68	9.503982	727	10.496018	10.021061	10.517079	18
43	9.483316	659	9.978898	67	9.504418	726	10.495582	10.021102	10.516684	17
44	9.483712	658	9.978858	68	9.504854	725	10.495146	10.021142	10.516288	16
45	9.484107	657	9.978817	67	9.505289	725	10.494711	10.021183	10.515893	15
46	9.484501	657	9.978777	67	9.505724	724	10.494276	10.021223	10.515499	14
47	9.484895	656	9.978737	68	9.506159	724	10.493841	10.021263	10.515105	13
48	9.485289	655	9.978696	68	9.506593	723	10.493407	10.021304	10.514711	12
49	9.485682	655	9.978655	67	9.507027	722	10.492973	10.021345	10.514318	11
50	9.486075	654	9.978615	68	9.507460	722	10.492540	10.021385	10.513925	10
51	9.486467	653	9.978574	68	9.507893	721	10.492107	10.021426	10.513533	9
52	9.486860	653	9.978533	67	9.508326	721	10.491674	10.021467	10.513140	8
53	9.487251	652	9.978493	68	9.508759	720	10.491241	10.021507	10.512749	7
54	9.487643	651	9.978452	68	9.509191	719	10.490809	10.021548	10.512357	6
55	9.488034	651	9.978411	68	9.509622	719	10.490378	10.021589	10.511966	5
56	9.488424	650	9.978370	68	9.510054	718	10.489946	10.021630	10.511576	4
57	9.488814	650	9.978329	68	9.510485	718	10.489515	10.021671	10.511186	3
58	9.489204	649	9.978288	68	9.510916	717	10.489084	10.021712	10.510796	2
59	9.489593	648	9.978247	68	9.511346	717	10.488654	10.021753	10.510407	1
60	9.489982		9.978206		9.511776		10.488224	10.021794	10.510018	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

72 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

18 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.489982	648	9.978206	68	9.511776	716	10.488224	10.021794	10.510018	60
1	9.490371	648	9.978165	68	9.512206	716	10.487794	10.021835	10.509629	59
2	9 490759	647	9.978124	68	9.512635	715	10.487365	10.021876	10.509241	58
3	9.491147	646	9.978083	69	9.513064	714	10.486936	10.021917	10.508853	57
4	9.491535	646	9.978042	69	9.513493	714	10.486507	10.021958	10.508465	56
5	9.491922	645	9.978001	69	9.513921	713	10.486079	10.021999	10.508078	55
6	9.492308	644	9.977959	69	9.514349	713	10.485651	10.022041	10.507692	54
7	9.492695	644	9.977918	69	9.514777	712	10.485223	10.022082	10.507305	53
8	9.493081	643	9.977877	69	9.515204	712	10.484796	10.022123	10. 06919	52
9	9 493466	642	9.977835	69	9.515631	711	10.484369	10.022165	10.506534	51
10	9.493851	642	9.977794	69	9.516057	710	10.483943	10.022206	10.506149	50
11	9.494236	641	9.977752	69	9.516184	710	10.483516	10.022248	10.505764	49
12	9.494621	641	9.977711	69	9.516910	709	10.483090	10.022289	10.505379	48
13	9.495005	640	9.977669	69	9.517335	709	10.482665	10.022331	10.504995	47
14	9.495388	639	9.977628	69	9.517761	708	10.482239	10.022372	10.504612	46
15	9.495772	639	9.977586	69	9.518185	708	10.481815	10.022414	10.504228	45
16	9.496154	638	9.977544	70	9.518610	707	10.481399	10.022456	10.503846	44
17	9.496537	637	9.977503	70	9.519034	706	10.480966	10.022497	10.503463	43
18	9.496919	637	9.977461	70	9.519458	706	10.480542	10.022539	10.503081	42
19	9.497301	636	9.977419	70	9.519882	705	10.480118	10.022581	10.502699	41
20	9.497682	636	9.977377	70	9.520305	705	10.479695	10.022623	10.502318	40
21	9.498064	635	9.977335	70	9.520728	704	10.479272	10.022665	10.501936	39
22	9.498444	634	9.977293	70	9.521151	704	10.478849	10.022707	10.501556	38
23	9.498825	634	9.977251	70	9.521573	703	10.478427	10.022749	10.501175	37
24	9.499204	633	9.977209	70	9.521995	703	10.478005	10.022791	10.500796	36
25	9.499584	632	9.977167	70	9.522417	702	10.477583	10.022833	10.500416	35
26	9.499963	632	9.977125	70	9.522838	702	10.477162	10.022875	10.500037	34
27	9.500342	631	9.977083	70	9.523259	701	10.476741	10.022917	10.499658	33
28	9.500721	631	9.977041	70	9.523680	701	10.476320	10.022959	10.499279	32
29	9.501099	630	9.976999	70	9.524100	700	10.475900	10.023001	10.498901	31
30	9.501476	629	9.976957	70	9.524520	699	10.475480	10.023043	10.498524	30
31	9.501854	629	9.976914	70	9.524939	699	10.475061	10.023086	10.498146	29
32	9.502231	628	9.976872	70	9.525359	698	10.474641	10.023128	10.497769	28
33	9.502607	628	9.976830	71	9.525778	698	10.474222	10.023170	10.497393	27
34	9.502984	627	9.976787	71	9.526197	697	10.473803	10.023213	10.497016	26
35	9.503360	626	9.976745	71	9.526615	697	10.473385	10.023255	10.496640	25
36	9.503735	626	9.976702	71	9.527033	696	10.472967	10.023298	10.496265	24
37	9.504110	625	9.976660	71	9.527451	696	10.472549	10.023340	10.495890	23
38	9.504485	625	9.976617	71	9.527868	695	10.472132	10.023383	10.495515	22
39	9.504860	624	9.976574	71	9.528285	695	10.471715	10.023426	10.495140	21
40	9.505234	623	9.976532	71	9.528702	694	10.471298	10.023468	10.494766	20
41	9.505608	623	9.976489	71	9.529119	694	10.470881	10.023511	10.494392	19
42	9.505981	622	9.976446	71	9.529535	693	10.470465	10.023554	10.494019	18
43	9.506354	622	9.976404	71	9.529950	693	10.470050	10.023596	10.493646	17
44	9.506727	621	9.976361	71	9.530366	692	10.469634	10.023639	10.493273	16
45	9.507099	620	9.976318	71	9.530781	691	10.469219	10.023682	10.492901	15
46	9.507471	620	9.976275	71	9.531196	691	10.468804	10.023725	10.492529	14
47	9.507843	619	9.976232	72	9.531611	690	10.468389	10.023768	10.492157	13
48	9.508214	619	9.976189	72	9.532025	690	10.467975	10.023811	10.491786	12
49	9.508585	618	9.976146	72	9.532439	689	10.467561	10.023854	10.491415	11
50	9.508956	618	9.976103	72	9.532853	689	10.467147	10.023897	10.491044	10
51	9.509326	617	9.976060	72	9.533266	688	10.466734	10.023940	10.490674	9
52	9.509696	616	9.976017	72	9.533679	688	10.466321	10.023983	10.490304	8
53	9.510065	616	9.975974	72	9.534092	687	10.465908	10.024026	10.489935	7
54	9.510434	615	9.975930	72	9.534504	687	10.465496	10.024070	10.489566	6
55	9.510803	615	9.975887	72	9.534916	686	10.465084	10.024113	10.489197	5
56	9.511172	614	9.975844	72	9.535328	686	10.464672	10.024156	10.488828	4
57	9.511540	613	9.975800	72	9.535739	685	10.464261	10.024200	10.488460	3
58	9.511907	613	9.975757	72	9.536150	685	10.463850	10.024243	10.488093	2
59	9.512275	612	9.975714	72	9.536561	684	10.463439	10.024286	10.487725	1
60	9.512642		9.975670		9.536972		10.463028	10.024330	10.487358	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

71 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

19 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.512642	612	9.975670	72	9.536972	684	10.463028	10.024330	10.487358	60
1	9.513009	611	9.975627	73	9.537382	683	10.462618	10.024373	10.486991	59
2	9.513375	611	9.975583	73	9.537792	683	10.462208	10.024417	10.486625	58
3	9.513741	610	9.975539	73	9.538202	682	10.461798	10.024461	10.486259	57
4	9.514107	609	9.975496	73	9.538611	682	10.461389	10.024504	10.485893	56
5	9.514472	609	9.975452	73	9.539020	681	10.460980	10.024548	10.485528	55
6	9.514837	608	9.975408	73	9.539429	681	10.460571	10.024592	10.485163	54
7	9.515202	608	9.975365	73	9.539837	680	10.460163	10.024635	10.484798	53
8	9.515566	607	9.975321	73	9.540245	680	10.459755	10.024679	10.484434	52
9	9.515930	607	9.975277	73	9.540653	679	10.459347	10.024723	10.484070	51
10	9.516294	606	9.975233	73	9.541061	679	10.458939	10.024767	10.483706	50
11	9.516657	605	9.975189	73	9.541468	678	10.458532	10.024811	10.483343	49
12	9.517020	605	9.975145	73	9.541875	678	10.458125	10.024855	10.482980	48
13	9.517382	604	9.975101	73	9.542281	677	10.457719	10.024899	10.482618	47
14	9.517745	604	9.975057	73	9.542688	677	10.457312	10.024943	10.482255	46
15	9.518107	603	9.975013	73	9.543094	676	10.456906	10.024987	10.481893	45
16	9.518468	603	9.974969	74	9.543499	676	10.456501	10.025031	10.481532	44
17	9.518829	602	9.974925	74	9.543905	675	10.456095	10.025075	10.481171	43
18	9.519190	601	9.974880	74	9.544310	675	10.455690	10.025120	10.480810	42
19	9.519551	601	9.974836	74	9.544715	674	10.455285	10.025164	10.480449	41
20	9.519911	600	9.974792	74	9.545119	674	10.454881	10.025208	10.480089	40
21	9.520271	600	9.974748	74	9.545524	673	10.454476	10.025252	10.479729	39
22	9.520634	599	9.974703	74	9.545928	673	10.454072	10.025297	10.479369	38
23	9.520990	599	9.974659	74	9.546331	672	10.453669	10.025341	10.479010	37
24	9.521349	598	9.974614	74	9.546735	672	10.453265	10.025386	10.478651	36
25	9.521707	598	9.974570	74	9.547138	671	10.452862	10.025430	10.478293	35
26	9.522066	597	9.974525	74	9.547540	671	10.452460	10.025475	10.477934	34
27	9.522424	596	9.974481	74	9.547943	670	10.452057	10.025519	10.477576	33
28	9.522781	596	9.974436	74	9.548345	670	10.451655	10.025564	10.477219	32
29	9.523138	595	9.974391	74	9.548747	669	10.451253	10.025609	10.476862	31
30	9.523495	595	9.974347	75	9.549149	669	10.450851	10.025653	10.476505	30
31	9.523852	594	9.974302	75	9.549550	668	10.450450	10.025698	10.476148	29
32	9.524208	594	9.974257	75	9.549951	668	10.450049	10.025743	10.475792	28
33	9.524564	593	9.974212	75	9.550352	667	10.449648	10.025788	10.475436	27
34	9.524920	593	9.974167	75	9.550752	667	10.449248	10.025833	10.475080	26
35	9.525275	592	9.974122	75	9.551152	666	10.448848	10.025878	10.474725	25
36	9.525630	591	9.974077	75	9.551552	666	10.448448	10.025923	10.474370	24
37	9.525984	591	9.974032	75	9.551952	665	10.448048	10.025968	10.474016	23
38	9.526339	590	9.973987	75	9.552351	665	10.447649	10.026013	10.473661	22
39	9.526693	590	9.973942	75	9.552750	665	10.447250	10.026058	10.473307	21
40	9.527046	589	9.973897	75	9.553149	664	10.446851	10.026103	10.472954	20
41	9.527400	589	9.973852	75	9.553548	664	10.446452	10.026148	10.472600	19
42	9.527753	588	9.973807	75	9.553946	663	10.446054	10.026193	10.472247	18
43	9.528105	588	9.973761	75	9.554344	663	10.445656	10.026239	10.471895	17
44	9.528458	587	9.973716	76	9.554741	662	10.445259	10.026284	10.471542	16
45	9.528810	587	9.973671	76	9.555139	662	10.444861	10.026329	10.471190	15
46	9.529161	586	9.973625	76	9.555536	661	10.444464	10.026375	10.470839	14
47	9.529513	586	9.973580	76	9.555933	661	10.444067	10.026420	10.470487	13
48	9.529864	585	9.973535	76	9.556329	660	10.443671	10.026465	10.470136	12
49	9.530215	585	9.973489	76	9.556725	660	10.443275	10.026511	10.469785	11
50	9.530565	584	9.973444	76	9.557121	659	10.442879	10.026556	10.469435	10
51	9.530915	584	9.973398	76	9.557517	659	10.442483	10.026602	10.469085	9
52	9.531265	583	9.973352	76	9.557913	659	10.442087	10.026648	10.468735	8
53	9.531614	582	9.973307	76	9.558308	658	10.441692	10.026693	10.468386	7
54	9.531963	582	9.973261	76	9.558702	658	10.441298	10.026739	10.468037	6
55	9.532312	581	9.973215	76	9.559097	657	10.440903	10.026785	10.467688	5
56	9.532661	581	9.973169	76	9.559491	657	10.440509	10.026831	10.467339	4
57	9.533009	580	9.973124	76	9.559885	656	10.440115	10.026876	10.466991	3
58	9.533357	580	9.973078	76	9.560279	656	10.439721	10.026922	10.466643	2
59	9.533704	579	9.973032	76	9.560673	655	10.439327	10.026968	10.466296	1
60	9.534052		9.972986		9.561066		10.438934	10.027014	10.465948	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

70 Degrees.

20 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.534052	578	9.972986	77	9.561066	655	10.438934	10.027014	10.465948	60
1	9.534399	577	9.972940	77	9.561459	654	10.438541	10.027060	10.465601	59
2	9.534745	577	9.972894	77	9.561851	654	10.438149	10.027106	10.465255	58
3	9.535092	577	9.972848	77	9.562244	653	10.437756	10.027152	10.464908	57
4	9.535438	576	9.972802	78	9.562636	653	10.437364	10.027198	10.464562	56
5	9.535783	576	9.972755	77	9.563028	653	10.436972	10.027245	10.464217	55
6	9.536129	575	9.972709	77	9.563419	652	10.436581	10.027291	10.463871	54
7	9.536474	574	9.972663	77	9.563811	652	10.436189	10.027337	10.463526	53
8	9.536818	574	9.972617	78	9.564202	651	10.435798	10.027383	10.463182	52
9	9.537163	573	9.972570	77	9.564592	651	10.435408	10.027430	10.462837	51
10	9.537507	573	9.972524	77	9.564983	650	10.435017	10.027476	10.462493	50
11	9.537851	572	9.972478	78	9.565373	650	10.434627	10.027522	10.462149	49
12	9.538194	572	9.972431	77	9.565763	649	10.434237	10.027569	10.461806	48
13	9.538538	571	9.972385	78	9.566153	649	10.433847	10.027615	10.461462	47
14	9.538880	571	9.972338	78	9.566542	649	10.433458	10.027662	10.461120	46
15	9.539223	570	9.972291	77	9.566932	648	10.433068	10.027709	10.460777	45
16	9.539565	570	9.972245	78	9.567320	648	10.432680	10.027755	10.460435	44
17	9.539907	569	9.972198	78	9.567709	647	10.432291	10.027802	10.460093	43
18	9.540249	569	9.972151	77	9.568098	647	10.431902	10.027849	10.459751	42
19	9.540590	568	9.972105	78	9.568486	646	10.431514	10.027895	10.459410	41
20	9.540931	568	9.972058	78	9.568873	646	10.431127	10.027942	10.459069	40
21	9.541272	567	9.972011	78	9.569261	645	10.430739	10.027989	10.458728	39
22	9.541613	567	9.971964	78	9.569648	645	10.430352	10.028036	10.458387	38
23	9.541953	566	9.971917	78	9.570035	645	10.429965	10.028083	10.458047	37
24	9.542293	566	9.971870	78	9.570422	644	10.429578	10.028130	10.457707	36
25	9.542632	565	9.971823	78	9.570809	644	10.429191	10.028177	10.457368	35
26	9.542971	565	9.971776	78	9.571195	643	10.428805	10.028224	10.457029	34
27	9.543310	564	9.971729	78	9.571581	643	10.428419	10.028271	10.456690	33
28	9.543649	564	9.971682	78	9.571967	642	10.428033	10.028318	10.456351	32
29	9.543987	563	9.971635	78	9.572352	642	10.427648	10.028365	10.456013	31
30	9.544325	563	9.971588	80	9.572738	642	10.427262	10.028412	10.455675	30
31	9.544663	562	9.971540	78	9.573123	641	10.426877	10.028460	10.455337	29
32	9.545000	562	9.971493	78	9.573507	641	10.426493	10.028507	10.455000	28
33	9.545338	561	9.971446	80	9.573892	640	10.426108	10.028554	10.454662	27
34	9.545674	561	9.971398	78	9.574276	640	10.425724	10.028602	10.454326	26
35	9.546011	560	9.971351	80	9.574660	639	10.425340	10.028649	10.453989	25
36	9.546347	560	9.971303	78	9.575044	639	10.424956	10.028697	10.453653	24
37	9.546683	559	9.971256	80	9.575427	639	10.424573	10.028744	10.453317	23
38	9.547019	559	9.971208	78	9.575810	638	10.424190	10.028792	10.452981	22
39	9.547354	558	9.971161	80	9.576193	638	10.423807	10.028839	10.452646	21
40	9.547689	558	9.971113	78	9.576576	637	10.423424	10.028887	10.452311	20
41	9.548024	557	9.971066	80	9.576958	637	10.423042	10.028934	10.451976	19
42	9.548359	557	9.971018	80	9.577341	636	10.422659	10.028982	10.451641	18
43	9.548693	556	9.970970	80	9.577723	636	10.422277	10.029030	10.451307	17
44	9.549027	556	9.970922	80	9.578104	636	10.421896	10.029078	10.450973	16
45	9.549360	555	9.970874	78	9.578486	635	10.421514	10.029126	10.450640	15
46	9.549693	555	9.970827	80	9.578867	635	10.421133	10.029173	10.450307	14
47	9.550026	554	9.970779	80	9.579248	634	10.420752	10.029221	10.449974	13
48	9.550359	554	9.970731	80	9.579629	634	10.420371	10.029269	10.449641	12
49	9.550692	553	9.970683	80	9.580009	634	10.419991	10.029317	10.449308	11
50	9.551024	553	9.970635	82	9.580389	633	10.419611	10.029365	10.448976	10
51	9.551356	552	9.970586	80	9.580769	633	10.419231	10.029414	10.448644	9
52	9.551687	552	9.970538	80	9.581149	632	10.418851	10.029462	10.448313	8
53	9.552018	552	9.970490	80	9.581528	632	10.418472	10.029510	10.447982	7
54	9.552349	551	9.970442	80	9.581907	632	10.418093	10.029558	10.447651	6
55	9.552680	551	9.970394	82	9.582286	631	10.417714	10.029606	10.447320	5
56	9.553010	550	9.970345	80	9.582665	631	10.417335	10.029655	10.446990	4
57	9.553341	550	9.970297	80	9.583043	630	10.416957	10.029703	10.446659	3
58	9.553670	549	9.970249	82	9.583422	630	10.416578	10.029751	10.446330	2
59	9.554000	549	9.970200	80	9.583800	629	10.416200	10.029800	10.446000	1
60	9.554329		9.970152		9.584177		10.415823	10.029848	10.445671	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

69 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

21 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.554329	548	9.970152	81	9.584177	629	10.415823	10.029848	10.445671	60
1	9.554658	548	9.970103	81	9.584555	629	10.415445	10.029897	10.445342	59
2	9.554987	547	9.970055	81	9.584932	628	10.415068	10.029945	10.445013	58
3	9.555315	547	9.970006	81	9.585309	628	10.414691	10.029994	10.444685	57
4	9.555643	546	9.969957	81	9.585686	627	10.414314	10.030043	10.444357	56
5	9.555971	546	9.969909	81	9.586062	627	10.413938	10.030091	10.444029	55
6	9.556299	545	9.969860	81	9.586439	627	10.413561	10.030140	10.443701	54
7	9.556626	545	9.969811	81	9.586815	626	10.413185	10.030189	10.443374	53
8	9.556953	544	9.969762	81	9.587190	626	10.412810	10.030238	10.443047	52
9	9.557280	544	9.969714	81	9.587566	625	10.412434	10.030286	10.442720	51
10	9.557606	543	9.969665	81	9.587941	625	10.412059	10.030335	10.442394	50
11	9.557932	543	9.969616	82	9.588316	625	10.411684	10.030384	10.442068	49
12	9.558258	543	9.969567	82	9.588691	624	10.411309	10.030433	10.441742	48
13	9.558583	542	9.969518	82	9.589066	624	10.410934	10.030482	10.441417	47
14	9.558909	542	9.969469	82	9.589440	623	10.410560	10.030531	10.441091	46
15	9.559234	541	9.969420	82	9.589814	623	10.410186	10.030580	10.440766	45
16	9.559558	541	9.969370	82	9.590188	623	10.409812	10.030630	10.440442	44
17	9.559883	540	9.969321	82	9.590562	622	10.409438	10.030679	10.440117	43
18	9.560207	540	9.969272	82	9.590935	622	10.409065	10.030728	10.439793	42
19	9.560531	539	9.969223	82	9.591308	622	10.408692	10.030777	10.439469	41
20	9.560855	539	9.969173	82	9.591681	621	10.408319	10.030827	10.439145	40
21	9.561178	538	9.969124	82	9.592054	621	10.407946	10.030876	10.438822	39
22	9.561501	538	9.969075	82	9.592426	620	10.407574	10.030925	10.438499	38
23	9.561824	537	9.969025	82	9.592798	620	10.407202	10.030975	10.438176	37
24	9.562146	537	9.968976	82	9.593171	620	10.406829	10.031024	10.437854	36
25	9.562468	536	9.968926	83	9.593542	619	10.406458	10.031074	10.437532	35
26	9.562790	536	9.968877	83	9.593914	619	10.406086	10.031123	10.437210	34
27	9.563112	536	9.968827	83	9.594285	618	10.405715	10.031173	10.436888	33
28	9.563433	535	9.968777	83	9.594656	618	10.405344	10.031223	10.436567	32
29	9.563755	535	9.968728	83	9.595027	618	10.404973	10.031272	10.436245	31
30	9.564075	534	9.968678	83	9.595398	617	10.404602	10.031322	10.435925	30
31	9.564396	534	9.968628	83	9.595768	617	10.404232	10.031372	10.435604	29
32	9.564716	533	9.968578	83	9.596138	616	10.403862	10.031422	10.435284	28
33	9.565036	533	9.968528	83	9.596508	616	10.403492	10.031472	10.434961	27
34	9.565356	532	9.968479	83	9.596878	616	10.403122	10.031521	10.434644	26
35	9.565676	532	9.968429	83	9.597247	615	10.402753	10.031571	10.434324	25
36	9.565995	531	9.968379	83	9.597616	615	10.402384	10.031621	10.434005	24
37	9.566314	531	9.968329	83	9.597985	615	10.402015	10.031671	10.433686	23
38	9.566632	531	9.968278	83	9.598354	614	10.401646	10.031722	10.433368	22
39	9.566951	530	9.968228	84	9.598722	614	10.401278	10.031772	10.433049	21
40	9.567269	530	9.968178	84	9.599091	613	10.400909	10.031822	10.432731	20
41	9.567587	529	9.968128	84	9.599459	613	10.400541	10.031872	10.432413	19
42	9.567904	529	9.968078	84	9.599827	613	10.400173	10.031922	10.432096	18
43	9.568222	528	9.968027	84	9.600194	612	10.399806	10.031973	10.431778	17
44	9.568539	528	9.967977	84	9.600562	612	10.399438	10.032023	10.431461	16
45	9.568856	528	9.967927	84	9.600929	611	10.399071	10.032073	10.431144	15
46	9.569172	527	9.967876	84	9.601296	611	10.398704	10.032124	10.430828	14
47	9.569488	527	9.967826	84	9.601662	611	10.398338	10.032174	10.430512	13
48	9.569804	526	9.967775	84	9.602029	610	10.397971	10.032225	10.430196	12
49	9.570120	526	9.967725	84	9.602395	610	10.397605	10.032275	10.429880	11
50	9.570435	525	9.967674	84	9.602761	610	10.397239	10.032326	10.429565	10
51	9.570751	525	9.967624	84	9.603127	609	10.396873	10.032376	10.429249	9
52	9.571066	524	9.967573	84	9.603493	609	10.396507	10.032427	10.428934	8
53	9.571380	524	9.967522	85	9.603858	609	10.396142	10.032478	10.428620	7
54	9.571695	523	9.967471	85	9.604223	608	10.395777	10.032529	10.428305	6
55	9.572009	523	9.967421	85	9.604588	608	10.395412	10.032579	10.427991	5
56	9.572323	523	9.967370	85	9.604953	607	10.395047	10.032630	10.427677	4
57	9.572636	522	9.967319	85	9.605317	607	10.394683	10.032681	10.427364	3
58	9.572950	522	9.967268	85	9.605682	607	10.394318	10.032732	10.427050	2
59	9.573263	521	9.967217	85	9.606046	606	10.393954	10.032783	10.426737	1
60	9.573575		9.967166		9.606410		10.393590	10.032834	10.426425	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

68 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

22 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.573575	521	9.967166	85	9.606410	606	10.393590	10.032834	10.426425	60
1	9.573888	520	9.967115	85	9.606773	606	10.393227	10.032885	10.426112	59
2	9.574200	520	9.967064	85	9.607137	605	10.392863	10.032936	10.425800	58
3	9.574512	519	9.967013	85	9.607500	605	10.392500	10.032987	10.425488	57
4	9.574824	519	9.966961	85	9.607863	604	10.392137	10.033039	10.425176	56
5	9.575136	519	9.966910	85	9.608225	604	10.391775	10.033090	10.424864	55
6	9.575447	518	9.966859	85	9.608588	604	10.391412	10.033141	10.424553	54
7	9.575758	518	9.966808	85	9.608950	603	10.391050	10.033192	10.424242	53
8	9.576069	517	9.966756	86	9.609312	603	10.390688	10.033244	10.423931	52
9	9.576379	517	9.966705	86	9.609674	603	10.390326	10.033295	10.423621	51
10	9.576689	516	9.966653	86	9.610036	602	10.389964	10.033347	10.423311	50
11	9.576999	516	9.966602	86	9.610397	602	10.389603	10.033398	10.423001	49
12	9.577309	516	9.966550	86	9.610759	602	10.389241	10.033450	10.422691	48
13	9.577618	515	9.966499	86	9.611120	601	10.388880	10.033501	10.422382	47
14	9.577927	515	9.966447	86	9.611480	601	10.388520	10.033553	10.422073	46
15	9.578236	514	9.966395	86	9.611841	601	10.388159	10.033605	10.421764	45
16	9.578545	514	9.966344	86	9.612201	600	10.387799	10.033656	10.421455	44
17	9.578853	513	9.966292	86	9.612561	600	10.387439	10.033708	10.421147	43
18	9.579162	513	9.966240	86	9.612921	600	10.387079	10.033760	10.420838	42
19	9.579470	513	9.966188	86	9.613281	599	10.386719	10.033812	10.420530	41
20	9.579777	512	9.966136	86	9.613641	599	10.386359	10.033864	10.420223	40
21	9.580085	512	9.966085	87	9.614000	598	10.386000	10.033915	10.419915	39
22	9.580392	511	9.966033	87	9.614359	598	10.385641	10.033967	10.419608	38
23	9.580699	511	9.965981	87	9.614718	598	10.385282	10.034019	10.419301	37
24	9.581005	511	9.965929	87	9.615077	597	10.384923	10.034071	10.418995	36
25	9.581312	510	9.965876	87	9.615435	597	10.384565	10.034124	10.418688	35
26	9.581618	510	9.965824	87	9.615793	597	10.384207	10.034176	10.418382	34
27	9.581924	509	9.965772	87	9.616151	596	10.383849	10.034228	10.418076	33
28	9.582229	509	9.965720	87	9.616509	596	10.383491	10.034280	10.417771	32
29	9.582535	509	9.965668	87	9.616867	596	10.383133	10.034332	10.417465	31
30	9.582840	508	9.965615	87	9.617224	595	10.382776	10.034385	10.417160	30
31	9.583145	508	9.965563	87	9.617582	595	10.382418	10.034437	10.416855	29
32	9.583449	507	9.965511	87	9.617939	595	10.382061	10.034489	10.416551	28
33	9.583754	507	9.965458	87	9.618295	594	10.381705	10.034542	10.416246	27
34	9.584058	506	9.965406	87	9.618652	594	10.381348	10.034594	10.415942	26
35	9.584361	506	9.965353	88	9.619008	594	10.380992	10.034647	10.415639	25
36	9.584665	506	9.965301	88	9.619364	593	10.380636	10.034699	10.415335	24
37	9.584968	505	9.965248	88	9.619721	593	10.380279	10.034752	10.415032	23
38	9.585272	505	9.965195	88	9.620076	593	10.379924	10.034805	10.414728	22
39	9.585574	504	9.965143	88	9.620432	592	10.379568	10.034857	10.414426	21
40	9.585877	504	9.965090	88	9.620787	592	10.379213	10.034910	10.414123	20
41	9.586179	503	9.965037	88	9.621142	592	10.378858	10.034963	10.413821	19
42	9.586482	503	9.964984	88	9.621497	591	10.378503	10.035016	10.413518	18
43	9.586783	503	9.964931	88	9.621852	591	10.378148	10.035069	10.413217	17
44	9.587085	502	9.964879	88	9.622207	590	10.377793	10.035121	10.412915	16
45	9.587386	502	9.964826	88	9.622561	590	10.377439	10.035174	10.412614	15
46	9.587688	501	9.964773	88	9.622915	590	10.377085	10.035227	10.412312	14
47	9.587989	501	9.964720	88	9.623269	589	10.376731	10.035280	10.412011	13
48	9.588289	501	9.964666	89	9.623623	589	10.376377	10.035334	10.411711	12
49	9.588590	500	9.964613	89	9.623976	589	10.376024	10.035387	10.411410	11
50	9.588890	500	9.964560	89	9.624330	588	10.375670	10.035440	10.411110	10
51	9.589190	499	9.964507	89	9.624683	588	10.375317	10.035493	10.410810	9
52	9.589489	499	9.964454	89	9.625036	588	10.374964	10.035546	10.410511	8
53	9.589789	499	9.964400	89	9.625388	587	10.374612	10.035600	10.410211	7
54	9.590088	498	9.964347	89	9.625741	587	10.374259	10.035653	10.409912	6
55	9.590387	498	9.964294	89	9.626093	587	10.373907	10.035706	10.409613	5
56	9.590686	497	9.964240	89	9.626445	586	10.373555	10.035760	10.409314	4
57	9.590984	497	9.964187	89	9.626797	586	10.373203	10.035813	10.409016	3
58	9.591282	497	9.964133	89	9.627149	586	10.372851	10.035867	10.408718	2
59	9.591580	496	9.964080	89	9.627501	585	10.372499	10.035920	10.408120	1
60	9.591878		9.964026		9.627852		10.372148	10.035974	10.408122	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

67 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

23 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.591878	496	9.964026	89	9.627852	585	10.372148	10.035974	10.408122	60
1	9.592176	495	9.963972	89	9.628203	585	10.371797	10.036028	10.407824	59
2	9.592473	495	9.963919	89	9.628554	585	10.371446	10.036081	10.407527	58
3	9.592770	495	9.963865	90	9.628905	584	10.371095	10.036135	10.407230	57
4	9.593067	494	9.963811	90	9.629255	584	10.370745	10.036189	10.406933	56
5	9.593363	494	9.963757	90	9.629606	583	10.370394	10.036243	10.406637	55
6	9.593659	493	9.963704	90	9.629956	583	10.370044	10.036296	10.406341	54
7	9.593955	493	9.963650	90	9.630306	583	10.369694	10.036350	10.406045	53
8	9.594251	493	9.963596	90	9.630656	583	10.369344	10.036404	10.405749	52
9	9.594547	492	9.963542	90	9.631005	582	10.368995	10.036458	10.405453	51
10	9.594842	492	9.963488	90	9.631355	582	10.368645	10.036512	10.405158	50
11	9.595137	491	9.963434	90	9.631704	582	10.368296	10.036566	10.404863	49
12	9.595432	491	9.963379	90	9.632053	581	10.367947	10.036621	10.404568	48
13	9.595727	491	9.963325	90	9.632401	581	10.367599	10.036675	10.404273	47
14	9.596021	490	9.963271	90	9.632750	581	10.367250	10.036729	10.403979	46
15	9.596315	490	9.963217	90	9.633098	580	10.366902	10.036783	10.403685	45
16	9.596609	489	9.963163	90	9.633447	580	10.366553	10.036837	10.403391	44
17	9.596903	489	9.963108	91	9.633795	580	10.366205	10.036892	10.403097	43
18	9.597196	489	9.963054	91	9.634143	579	10.365857	10.036946	10.402804	42
19	9.597490	488	9.962999	91	9.634490	579	10.365510	10.037001	10.402510	41
20	9.597783	488	9.962945	91	9.634838	579	10.365162	10.037055	10.402217	40
21	9.598075	487	9.962890	91	9.635185	578	10.364815	10.037110	10.401925	39
22	9.598368	487	9.962836	91	9.635532	578	10.364468	10.037164	10.401632	38
23	9.598660	487	9.962781	91	9.635879	578	10.364121	10.037219	10.401340	37
24	9.598952	486	9.962727	91	9.636226	577	10.363774	10.037273	10.401048	36
25	9.599244	486	9.962672	91	9.636572	577	10.363428	10.037328	10.400756	35
26	9.599536	485	9.962617	91	9.636919	577	10.363081	10.037383	10.400464	34
27	9.599827	485	9.962562	91	9.637265	577	10.362735	10.037438	10.400173	33
28	9.600118	485	9.962508	91	9.637611	576	10.362389	10.037492	10.399882	32
29	9.600409	484	9.962453	91	9.637956	576	10.362044	10.037547	10.399591	31
30	9.600700	484	9.962398	92	9.638302	576	10.361698	10.037602	10.399300	30
31	9.600990	484	9.962343	92	9.638647	575	10.361353	10.037657	10.399010	29
32	9.601280	483	9.962288	92	9.638992	575	10.361008	10.037712	10.398720	28
33	9.601570	483	9.962233	92	9.639337	575	10.360663	10.037767	10.398430	27
34	9.601860	482	9.962178	92	9.639682	574	10.360318	10.037822	10.398140	26
35	9.602150	482	9.962123	92	9.640027	574	10.359973	10.037877	10.397850	25
36	9.602139	482	9.962067	92	9.640371	574	10.359629	10.037933	10.397561	24
37	9.602728	481	9.962012	92	9.640716	573	10.359284	10.037988	10.397272	23
38	9.603017	481	9.961957	92	9.641060	573	10.358940	10.038043	10.396983	22
39	9.603305	481	9.961902	92	9.641404	573	10.358596	10.038098	10.396695	21
40	9.603594	480	9.961846	92	9.641747	572	10.358253	10.038154	10.396406	20
41	9.603882	480	9.961791	92	9.642091	572	10.357909	10.038209	10.396118	19
42	9.604170	479	9.961735	92	9.642434	572	10.357566	10.038265	10.395830	18
43	9.604457	479	9.961680	92	9.642777	572	10.357223	10.038320	10.395543	17
44	9.604745	479	9.961624	93	9.643120	571	10.356880	10.038376	10.395255	16
45	9.605032	478	9.961569	93	9.643463	571	10.356537	10.038431	10.394968	15
46	9.605319	478	9.961513	93	9.643806	571	10.356194	10.038487	10.394681	14
47	9.605606	478	9.961458	93	9.644148	570	10.355852	10.038542	10.394394	13
48	9.605892	477	9.961402	93	9.644490	570	10.355510	10.038598	10.394108	12
49	9.606179	477	9.961346	93	9.644832	570	10.355168	10.038654	10.393821	11
50	9.606165	476	9.961290	93	9.645174	570	10.354826	10.038710	10.393535	10
51	9.606751	476	9.961235	93	9.645516	569	10.354484	10.038765	10.393249	9
52	9.607036	476	9.961179	93	9.645857	569	10.354143	10.038821	10.392964	8
53	9.607322	475	9.961123	93	9.646199	569	10.353801	10.038877	10.392678	7
54	9.607607	475	9.961067	93	9.646540	568	10.353460	10.038933	10.392393	6
55	9.607892	474	9.961011	93	9.646881	568	10.353119	10.038989	10.392108	5
56	9.608177	474	9.960955	93	9.647222	568	10.352778	10.039045	10.391823	4
57	9.608461	474	9.960899	93	9.647562	567	10.352438	10.039101	10.391539	3
58	9.608745	473	9.960843	94	9.647903	567	10.352097	10.039157	10.391255	2
59	9.609029	473	9.960786	94	9.648243	567	10.351757	10.039214	10.390971	1
60	9.609313		9.960730		9.648583		10.351417	10.039270	10.390687	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

66 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

24 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.609313	473	9.960730	94	9.648583	566	10.351417	10.039270	10.390687	60
1	9.609597	472	9.960674	94	9.648923	566	10.351077	10.039326	10.390403	59
2	9.609880	472	9.960618	94	9.649263	566	10.350737	10.039382	10.390120	58
3	9.610164	472	9.960561	94	9.649602	566	10.350398	10.039439	10.389836	57
4	9.610447	471	9.960505	94	9.649942	565	10.350058	10.039495	10.389553	56
5	9.610729	471	9.960148	94	9.650281	565	10.349719	10.039552	10.389271	55
6	9.611012	470	9.960392	94	9.650620	565	10.349380	10.039608	10.388988	54
7	9.611294	470	9.960335	94	9.650959	564	10.349041	10.039665	10.388706	53
8	9.611576	470	9.960279	94	9.651297	564	10.348703	10.039721	10.388424	52
9	9.611858	469	9.960222	94	9.651636	564	10.348364	10.039778	10.388142	51
10	9.612140	469	9.960165	94	9.651974	563	10.348026	10.039835	10.387860	50
11	9.612421	469	9.960109	95	9.652312	563	10.347688	10.039891	10.387579	49
12	9.612702	468	9.960052	95	9.652650	563	10.347350	10.039948	10.387298	48
13	9.612983	468	9.959995	95	9.652988	563	10.347012	10.040005	10.387017	47
14	9.613264	467	9.959938	95	9.653326	562	10.346674	10.040062	10.386736	46
15	9.613545	467	9.959882	95	9.653663	562	10.346337	10.040118	10.386455	45
16	9.613825	467	9.959825	95	9.654000	562	10.346000	10.040175	10.386175	44
17	9.614105	466	9.959768	95	9.654337	561	10.345663	10.040232	10.385895	43
18	9.614385	466	9.959711	95	9.654674	561	10.345326	10.040289	10.385615	42
19	9.614665	466	9.959654	95	9.655011	561	10.344989	10.040346	10.385335	41
20	9.614944	465	9.959596	95	9.655348	561	10.344652	10.040404	10.385056	40
21	9.615223	465	9.959539	95	9.655684	560	10.344316	10.040461	10.384777	39
22	9.615502	465	9.959182	95	9.656020	560	10.343980	10.040518	10.384498	38
23	9.615781	464	9.959425	95	9.656356	560	10.343644	10.040575	10.384219	37
24	9.616060	464	9.959368	95	9.656692	559	10.343308	10.040632	10.383940	36
25	9.616338	464	9.959310	96	9.657028	559	10.342972	10.040690	10.383662	35
26	9.616616	463	9.959253	96	9.657364	559	10.342636	10.040747	10.383384	34
27	9.616894	463	9.959195	96	9.657699	559	10.342301	10.040805	10.383106	33
28	9.617172	462	9.959138	96	9.658034	558	10.341966	10.040862	10.382828	32
29	9.617450	462	9.959080	96	9.658369	558	10.341631	10.040919	10.382550	31
30	9.617727	462	9.959023	96	9.658704	558	10.341296	10.040977	10.382273	30
31	9.618004	461	9.958965	96	9.659039	558	10.340961	10.041035	10.381996	29
32	9.618281	461	9.958908	96	9.659373	557	10.340627	10.041092	10.381719	28
33	9.618558	461	9.958850	96	9.659708	557	10.340292	10.041150	10.381442	27
34	9.618834	460	9.958792	96	9.660042	557	10.339958	10.041208	10.381166	26
35	9.619110	460	9.958734	96	9.660376	556	10.339624	10.041266	10.380890	25
36	9.619386	460	9.958677	96	9.660710	556	10.339290	10.041323	10.380614	24
37	9.619662	459	9.958619	96	9.661043	556	10.338957	10.041381	10.380338	23
38	9.619938	459	9.958561	96	9.661377	556	10.338623	10.041439	10.380062	22
39	9.620213	459	9.958503	97	9.661710	555	10.338290	10.041497	10.379787	21
40	9.620488	458	9.958145	97	9.662043	555	10.337957	10.041555	10.379512	20
41	9.620763	458	9.958387	97	9.662376	555	10.337624	10.041613	10.379237	19
42	9.621038	457	9.958329	97	9.662709	554	10.337291	10.041671	10.378962	18
43	9.621313	457	9.958271	97	9.663042	554	10.336958	10.041729	10.378687	17
44	9.621587	457	9.958213	97	9.663375	554	10.336625	10.041787	10.378413	16
45	9.621861	456	9.958154	97	9.663707	554	10.336293	10.041846	10.378139	15
46	9.622135	456	9.958096	97	9.664039	553	10.335961	10.041904	10.377865	14
47	9.622409	456	9.958038	97	9.664371	553	10.335629	10.041962	10.377591	13
48	9.622682	455	9.957979	97	9.664703	553	10.335297	10.042021	10.377318	12
49	9.622956	455	9.957921	97	9.665035	553	10.334965	10.042079	10.377044	11
50	9.623229	455	9.957863	97	9.665366	552	10.334634	10.042137	10.376771	10
51	9.623502	454	9.957804	97	9.665697	552	10.334303	10.042196	10.376498	9
52	9.623774	454	9.957746	98	9.666029	552	10.333971	10.042254	10.376226	8
53	9.624047	454	9.957687	98	9.666360	551	10.333640	10.042313	10.375953	7
54	9.624319	453	9.957628	98	9.666691	551	10.333309	10.042372	10.375681	6
55	9.624591	453	9.957570	98	9.667021	551	10.332979	10.042430	10.375409	5
56	9.624863	453	9.957511	98	9.667352	551	10.332648	10.042489	10.375137	4
57	9.625135	452	9.957452	98	9.667682	550	10.332318	10.042548	10.374865	3
58	9.625406	452	9.957393	98	9.668013	550	10.331987	10.042607	10.374594	2
59	9.625677	452	9.957335	98	9.668343	550	10.331657	10.042665	10.374323	1
60	9.625948		9.957276		9.668672		10.331328	10.042724	10.374052	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

65 Degrees.

TABLE XXV.
LOGARITHMIC SINES, TANGENTS, AND SECANTS.

25 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.625948	451	9.957276	98	9.668673	550	10.331327	10.042724	10.374052	60
1	9.626219	451	9.957217	98	9.669002	549	10.330998	10.042783	10.373781	59
2	9.626490	451	9.957158	98	9.669332	549	10.330668	10.042842	10.373510	58
3	9.626760	450	9.957099	98	9.669661	549	10.330339	10.042901	10.373240	57
4	9.627030	450	9.957040	98	9.669991	548	10.330009	10.042960	10.372970	56
5	9.627300	450	9.956981	98	9.670320	548	10.329680	10.043019	10.372700	55
6	9.627570	449	9.956921	99	9.670649	548	10.329351	10.043079	10.372430	54
7	9.627840	449	9.956862	99	9.670977	548	10.329023	10.043138	10.372160	53
8	9.628109	449	9.956803	99	9.671306	547	10.328694	10.043197	10.371891	52
9	9.628378	448	9.956744	99	9.671634	547	10.328366	10.043256	10.371622	51
10	9.628647	448	9.956684	99	9.671963	547	10.328037	10.043316	10.371353	50
11	9.628916	447	9.956625	99	9.672291	547	10.327709	10.043375	10.371084	49
12	9.629185	447	9.956566	99	9.672619	546	10.327381	10.043434	10.370815	48
13	9.629453	447	9.956506	99	9.672947	546	10.327053	10.043494	10.370547	47
14	9.629721	446	9.956447	99	9.673274	546	10.326726	10.043553	10.370279	46
15	9.629989	446	9.956387	99	9.673602	546	10.326398	10.043613	10.370011	45
16	9.630257	446	9.956327	99	9.673929	545	10.326071	10.043673	10.369743	44
17	9.630524	446	9.956268	99	9.674257	545	10.325743	10.043732	10.369476	43
18	9.630792	445	9.956208	100	9.674584	545	10.325416	10.043792	10.369208	42
19	9.631059	445	9.956148	100	9.674910	544	10.325090	10.043852	10.368941	41
20	9.631326	445	9.956089	100	9.675237	544	10.324763	10.043911	10.368674	40
21	9.631593	444	9.956029	100	9.675564	544	10.324436	10.043971	10.368407	39
22	9.631859	444	9.955969	100	9.675890	544	10.324110	10.044031	10.368141	38
23	9.632125	444	9.955909	100	9.676217	543	10.323783	10.044091	10.367875	37
24	9.632392	443	9.955849	100	9.676543	543	10.323457	10.044151	10.367608	36
25	9.632658	443	9.955789	100	9.676869	543	10.323131	10.044211	10.367342	35
26	9.632923	443	9.955729	100	9.677194	543	10.322806	10.044271	10.367077	34
27	9.633189	442	9.955669	100	9.677520	542	10.322480	10.044331	10.366811	33
28	9.633454	442	9.955609	100	9.677846	542	10.322154	10.044391	10.366546	32
29	9.633719	442	9.955548	100	9.678171	542	10.321829	10.044452	10.366281	31
30	9.633984	441	9.955488	100	9.678496	542	10.321504	10.044512	10.366016	30
31	9.634249	441	9.955428	101	9.678821	541	10.321179	10.044572	10.365751	29
32	9.634514	440	9.955368	101	9.679146	541	10.320854	10.044632	10.365486	28
33	9.634778	440	9.955307	101	9.679471	541	10.320529	10.044693	10.365222	27
34	9.635042	440	9.955247	101	9.679795	541	10.320205	10.044753	10.364958	26
35	9.635306	439	9.955186	101	9.680120	540	10.319880	10.044814	10.364694	25
36	9.635570	439	9.955126	101	9.680444	540	10.319556	10.044874	10.364430	24
37	9.635834	439	9.955065	101	9.680768	540	10.319232	10.044935	10.364166	23
38	9.636097	438	9.955005	101	9.681092	540	10.318908	10.044995	10.363903	22
39	9.636360	438	9.954944	101	9.681416	539	10.318584	10.045056	10.363640	21
40	9.636623	438	9.954883	101	9.681740	539	10.318260	10.045117	10.363377	20
41	9.636886	437	9.954823	101	9.682063	539	10.317937	10.045177	10.363114	19
42	9.637148	437	9.954762	101	9.682387	539	10.317613	10.045238	10.362852	18
43	9.637411	437	9.954701	101	9.682710	538	10.317290	10.045299	10.362589	17
44	9.637673	437	9.954640	101	9.683033	538	10.316967	10.045360	10.362327	16
45	9.637935	436	9.954579	101	9.683356	538	10.316644	10.045421	10.362065	15
46	9.638197	436	9.954518	102	9.683679	538	10.316321	10.045482	10.361803	14
47	9.638458	436	9.954457	102	9.684001	537	10.315999	10.045543	10.361542	13
48	9.638720	435	9.954396	102	9.684324	537	10.315676	10.045604	10.361280	12
49	9.638981	435	9.954335	102	9.684646	537	10.315354	10.045665	10.361019	11
50	9.639242	435	9.954274	102	9.684968	537	10.315032	10.045726	10.360758	10
51	9.639503	434	9.954213	102	9.685290	536	10.314710	10.045787	10.360497	9
52	9.639764	434	9.954152	102	9.685612	536	10.314388	10.045848	10.360236	8
53	9.640024	434	9.954090	102	9.685934	536	10.314066	10.045910	10.359976	7
54	9.640284	433	9.954029	102	9.686255	536	10.313745	10.045971	10.359716	6
55	9.640544	433	9.953968	102	9.686577	535	10.313423	10.046032	10.359456	5
56	9.640804	433	9.953906	102	9.686898	535	10.313102	10.046094	10.359196	4
57	9.641064	432	9.953845	102	9.687219	535	10.312781	10.046155	10.358936	3
58	9.641324	432	9.953783	102	9.687540	535	10.312460	10.046217	10.358676	2
59	9.641583	432	9.953722	103	9.687861	534	10.312139	10.046278	10.358417	1
60	9.641842		9.953660		9.688182		10.311818	10.046340	10.358158	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

64 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

26 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.641842	431	9.953660	103	9.688182	534	10.311818	10.046340	10.358158	60
1	9.642101	431	9.953599	103	9.688502	534	10.311498	10.046101	10.357899	59
2	9.642360	431	9.953537	103	9.688823	534	10.311177	10.046463	10.357640	58
3	9.642618	430	9.953475	103	9.689143	533	10.310857	10.046525	10.357382	57
4	9.642877	430	9.953413	103	9.689463	533	10.310537	10.046587	10.357123	56
5	9.643135	430	9.953352	103	9.689783	533	10.310217	10.046648	10.356865	55
6	9.643393	430	9.953290	103	9.690103	533	10.309897	10.046710	10.356607	54
7	9.643650	429	9.953228	103	9.690423	533	10.309577	10.046772	10.356350	53
8	9.643908	429	9.953166	103	9.690742	532	10.309258	10.046834	10.356092	52
9	9.644165	429	9.953104	103	9.691062	532	10.308938	10.046896	10.355835	51
10	9.644423	428	9.953042	103	9.691381	532	10.308619	10.046958	10.355577	50
11	9.644680	428	9.952980	104	9.691700	531	10.308300	10.047020	10.355320	49
12	9.644936	428	9.952918	104	9.692019	531	10.307981	10.047082	10.355064	48
13	9.645193	427	9.952855	104	9.692338	531	10.307662	10.047145	10.354807	47
14	9.645450	427	9.952793	104	9.692656	531	10.307344	10.047207	10.354550	46
15	9.645706	427	9.952731	104	9.692975	531	10.307025	10.047269	10.354294	45
16	9.645962	426	9.952669	104	9.693293	530	10.306707	10.047331	10.354038	44
17	9.646218	426	9.952606	104	9.693612	530	10.306388	10.047394	10.353782	43
18	9.646474	426	9.952544	104	9.693930	530	10.306070	10.047456	10.353526	42
19	9.646729	425	9.952481	104	9.694248	530	10.305752	10.047519	10.353271	41
20	9.646984	425	9.952419	104	9.694566	529	10.305434	10.047581	10.353016	40
21	9.647240	425	9.952356	104	9.694883	529	10.305117	10.047644	10.352760	39
22	9.647494	424	9.952294	104	9.695201	529	10.304799	10.047706	10.352506	38
23	9.647749	424	9.952231	104	9.695518	529	10.304482	10.047769	10.352251	37
24	9.648004	424	9.952168	105	9.695836	529	10.304164	10.047832	10.351996	36
25	9.648258	424	9.952106	105	9.696153	528	10.303847	10.047894	10.351742	35
26	9.648512	423	9.952043	105	9.696470	528	10.303530	10.047957	10.351488	34
27	9.648766	423	9.951980	105	9.696787	528	10.303213	10.048020	10.351234	33
28	9.649020	423	9.951917	105	9.697103	528	10.302897	10.048083	10.350980	32
29	9.649274	422	9.951854	105	9.697420	527	10.302580	10.048146	10.350726	31
30	9.649527	422	9.951791	105	9.697736	527	10.302264	10.048209	10.350473	30
31	9.649781	422	9.951728	105	9.698053	527	10.301947	10.048272	10.350219	29
32	9.650034	422	9.951665	105	9.698369	527	10.301631	10.048335	10.349966	28
33	9.650287	421	9.951602	105	9.698685	526	10.301315	10.048398	10.349713	27
34	9.650539	421	9.951539	105	9.699001	526	10.300999	10.048461	10.349461	26
35	9.650792	421	9.951476	105	9.699316	526	10.300684	10.048524	10.349208	25
36	9.651044	420	9.951412	105	9.699632	526	10.300368	10.048588	10.348956	24
37	9.651297	420	9.951349	106	9.699947	526	10.300053	10.048651	10.348703	23
38	9.651549	420	9.951286	106	9.700263	525	10.299737	10.048714	10.348451	22
39	9.651800	419	9.951222	106	9.700578	525	10.299422	10.048778	10.348200	21
40	9.652052	419	9.951159	106	9.700893	525	10.299107	10.048841	10.347948	20
41	9.652304	419	9.951096	106	9.701208	525	10.298792	10.048904	10.347696	19
42	9.652555	418	9.951032	106	9.701523	524	10.298477	10.048968	10.347445	18
43	9.652806	418	9.950968	106	9.701837	524	10.298163	10.049032	10.347194	17
44	9.653057	418	9.950905	106	9.702152	521	10.297848	10.049095	10.346943	16
45	9.653308	418	9.950841	106	9.702466	524	10.297534	10.049159	10.346692	15
46	9.653558	417	9.950778	106	9.702780	523	10.297220	10.049222	10.346442	14
47	9.653808	417	9.950714	106	9.703095	523	10.296905	10.049286	10.346192	13
48	9.654059	417	9.950650	106	9.703409	523	10.296591	10.049350	10.345941	12
49	9.654309	416	9.950586	106	9.703723	523	10.296277	10.049414	10.345691	11
50	9.654558	416	9.950522	107	9.704036	523	10.295964	10.049478	10.345442	10
51	9.654808	416	9.950458	107	9.704350	522	10.295650	10.049542	10.345192	9
52	9.655058	415	9.950394	107	9.704663	522	10.295337	10.049606	10.344942	8
53	9.655307	415	9.950330	107	9.704977	522	10.295023	10.049670	10.344693	7
54	9.655556	415	9.950266	107	9.705290	522	10.294710	10.049734	10.344444	6
55	9.655805	415	9.950202	107	9.705603	521	10.294397	10.049798	10.344195	5
56	9.656054	414	9.950138	107	9.705916	521	10.294084	10.049862	10.343946	4
57	9.656302	414	9.950074	107	9.706228	521	10.293772	10.049926	10.343698	3
58	9.656551	414	9.950010	107	9.706541	521	10.293459	10.049990	10.343449	2
59	9.656799	413	9.949945	107	9.706854	521	10.293146	10.050055	10.343201	1
60	9.657047		9.949881		9.707166		10.292834	10.050119	10.342953	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

63 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

27 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.657047	413	9.949881	107	9.707166	520	10.292834	10.050119	10.342953	60
1	9.657295	413	9.949816	107	9.707478	520	10.292522	10.050184	10.342705	59
2	9.657542	412	9.949752	107	9.707790	520	10.292210	10.050248	10.342458	58
3	9.657790	412	9.949688	108	9.708102	520	10.291898	10.050312	10.342210	57
4	9.658037	412	9.949623	108	9.708414	519	10.291586	10.050377	10.341963	56
5	9.658284	412	9.949558	108	9.708726	519	10.291274	10.050442	10.341716	55
6	9.658531	411	9.949494	108	9.709037	519	10.290963	10.050506	10.341469	54
7	9.658778	411	9.949429	108	9.709349	519	10.290651	10.050571	10.341222	53
8	9.659025	411	9.949364	108	9.709660	519	10.290340	10.050636	10.340975	52
9	9.659271	410	9.949300	108	9.709971	518	10.290029	10.050700	10.340729	51
10	9.659517	410	9.949235	108	9.710282	518	10.289718	10.050765	10.340483	50
11	9.659763	410	9.949170	108	9.710593	518	10.289407	10.050830	10.340237	49
12	9.660009	409	9.949105	108	9.710904	518	10.289096	10.050895	10.339991	48
13	9.660255	409	9.949040	108	9.711215	518	10.288785	10.050960	10.339745	47
14	9.660501	409	9.948975	108	9.711525	517	10.288475	10.051025	10.339499	46
15	9.660746	409	9.948910	108	9.711836	517	10.288164	10.051090	10.339254	45
16	9.660991	408	9.948845	108	9.712146	517	10.287854	10.051155	10.339009	44
17	9.661236	408	9.948780	109	9.712456	517	10.287544	10.051220	10.338764	43
18	9.661481	408	9.948715	109	9.712766	516	10.287234	10.051285	10.338519	42
19	9.661726	407	9.948650	109	9.713076	516	10.286924	10.051350	10.338274	41
20	9.661970	407	9.948584	109	9.713386	516	10.286614	10.051416	10.338030	40
21	9.662214	407	9.948519	109	9.713696	516	10.286304	10.051481	10.337786	39
22	9.662459	407	9.948454	109	9.714005	516	10.285995	10.051546	10.337541	38
23	9.662703	406	9.948388	109	9.714314	515	10.285686	10.051612	10.337297	37
24	9.662946	406	9.948323	109	9.714624	515	10.285376	10.051677	10.337054	36
25	9.663190	406	9.948257	109	9.714933	515	10.285067	10.051743	10.336810	35
26	9.663433	405	9.948192	109	9.715242	515	10.284758	10.051808	10.336567	34
27	9.663677	405	9.948126	109	9.715551	514	10.284449	10.051874	10.336323	33
28	9.663920	405	9.948060	109	9.715860	514	10.284140	10.051940	10.336080	32
29	9.664163	405	9.947995	110	9.716168	514	10.283832	10.052005	10.335837	31
30	9.664406	404	9.947929	110	9.716477	514	10.283523	10.052071	10.335594	30
31	9.664648	404	9.947863	110	9.716785	514	10.283215	10.052137	10.335352	29
32	9.664891	404	9.947797	110	9.717093	513	10.282907	10.052203	10.335109	28
33	9.665133	403	9.947731	110	9.717401	513	10.282599	10.052269	10.334867	27
34	9.665375	403	9.947665	110	9.717709	513	10.282291	10.052335	10.334625	26
35	9.665617	403	9.947600	110	9.718017	513	10.281983	10.052400	10.334383	25
36	9.665859	402	9.947533	110	9.718325	513	10.281675	10.052467	10.334141	24
37	9.666100	402	9.947467	110	9.718633	512	10.281367	10.052533	10.333900	23
38	9.666342	402	9.947401	110	9.718940	512	10.281060	10.052599	10.333658	22
39	9.666583	402	9.947335	110	9.719248	512	10.280752	10.052665	10.333417	21
40	9.666824	401	9.947269	110	9.719555	512	10.280445	10.052731	10.333176	29
41	9.667065	401	9.947203	110	9.719862	512	10.280138	10.052797	10.332935	19
42	9.667305	401	9.947136	111	9.720169	511	10.279831	10.052864	10.332695	18
43	9.667546	401	9.947070	111	9.720476	511	10.279524	10.052930	10.332454	17
44	9.667786	400	9.947004	111	9.720783	511	10.279217	10.052996	10.332214	16
45	9.668027	400	9.946937	111	9.721089	511	10.278911	10.053063	10.331973	15
46	9.668267	400	9.946871	111	9.721396	511	10.278604	10.053129	10.331733	14
47	9.668506	399	9.946804	111	9.721702	510	10.278298	10.053196	10.331494	13
48	9.668746	399	9.946738	111	9.722009	510	10.277991	10.053262	10.331254	12
49	9.668986	399	9.946671	111	9.722315	510	10.277685	10.053329	10.331014	11
50	9.669225	399	9.946604	111	9.722621	510	10.277379	10.053396	10.330775	10
51	9.669464	398	9.946538	111	9.722927	510	10.277073	10.053462	10.330536	9
52	9.669703	398	9.946471	111	9.723232	509	10.276768	10.053529	10.330297	8
53	9.669942	398	9.946404	111	9.723538	509	10.276462	10.053596	10.330058	7
54	9.670181	397	9.946337	111	9.723844	509	10.276156	10.053663	10.329819	6
55	9.670419	397	9.946270	112	9.724149	509	10.275851	10.053730	10.329581	5
56	9.670658	397	9.946203	112	9.724454	509	10.275546	10.053797	10.329342	4
57	9.670896	397	9.946136	112	9.724759	508	10.275241	10.053864	10.329104	3
58	9.671134	396	9.946069	112	9.725065	508	10.274935	10.053931	10.328866	2
59	9.671372	396	9.946002	112	9.725369	508	10.274631	10.053998	10.328628	1
60	9.671609		9.945935		9.725674		10.274326	10.054065	10.328391	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

62 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

28 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.671609	396	9.945935	112	9.725674	508	10.274326	10.054065	10.328391	60
1	9.671847	395	9.945868	112	9.725979	508	10.274021	10.054132	10.328153	59
2	9.672084	395	9.945800	112	9.726284	507	10.273716	10.054200	10.327916	58
3	9.672321	395	9.945733	112	9.726588	507	10.273412	10.054267	10.327679	57
4	9.672558	395	9.945666	112	9.726892	507	10.273108	10.054334	10.327442	56
5	9.672795	394	9.945598	112	9.727197	507	10.272803	10.054402	10.327205	55
6	9.673032	394	9.945531	112	9.727501	507	10.272499	10.054469	10.326968	54
7	9.673268	394	9.945464	113	9.727805	506	10.272195	10.054536	10.326732	53
8	9.673505	394	9.945396	113	9.728109	506	10.271891	10.054604	10.326495	52
9	9.673741	393	9.945328	113	9.728412	506	10.271588	10.054672	10.326259	51
10	9.673977	393	9.945261	113	9.728716	506	10.271284	10.054739	10.326023	50
11	9.674213	393	9.945193	113	9.729020	506	10.270980	10.054807	10.325787	49
12	9.674448	392	9.945125	113	9.729323	505	10.270677	10.054875	10.325552	48
13	9.674684	392	9.945058	113	9.729626	505	10.270374	10.054942	10.325316	47
14	9.674919	392	9.944990	113	9.729929	505	10.270071	10.055010	10.325081	46
15	9.675155	392	9.944922	113	9.730233	505	10.269767	10.055078	10.324845	45
16	9.675390	391	9.944854	113	9.730535	505	10.269465	10.055146	10.324610	44
17	9.675624	391	9.944786	113	9.730838	504	10.269162	10.055214	10.324376	43
18	9.675859	391	9.944718	113	9.731141	504	10.268859	10.055282	10.324141	42
19	9.676094	391	9.944650	113	9.731444	504	10.268556	10.055350	10.323906	41
20	9.676328	390	9.944582	114	9.731746	504	10.268254	10.055418	10.323672	40
21	9.676562	390	9.944514	114	9.732048	504	10.267952	10.055486	10.323438	39
22	9.676796	390	9.944446	114	9.732351	503	10.267649	10.055554	10.323204	38
23	9.677030	390	9.944377	114	9.732653	503	10.267347	10.055623	10.322970	37
24	9.677264	389	9.944309	114	9.732955	503	10.267045	10.055691	10.322736	36
25	9.677498	389	9.944241	114	9.733257	503	10.266743	10.055759	10.322502	35
26	9.677731	389	9 944172	114	9.733558	503	10.266442	10.055828	10.322269	34
27	9.677964	388	9.944104	114	9.733860	503	10.266140	10.055896	10.322036	33
28	9.678197	388	9.944036	114	9.734162	502	10.265838	10.055964	10.321803	32
29	9.678430	388	9.943967	114	9.734463	502	10.265537	10.056033	10.321570	31
30	9.678663	388	9.943899	114	9.734764	502	10.265236	10.056101	10.321337	30
31	9.678895	387	9.943830	114	9.735066	502	10.264934	10.056170	10.321105	29
32	9.679128	387	9.943761	114	9.735367	502	10.264633	10.056239	10.320872	28
33	9.679360	387	9.943693	115	9.735668	501	10.264332	10.056307	10.320640	27
34	9.679592	387	9.943624	115	9.735969	501	10.264031	10.056376	10.320408	26
35	9.679824	386	9.943555	115	9.736269	501	10.263731	10.056445	10.320176	25
36	9.680056	386	9.943486	115	9.736570	501	10.263430	10.056514	10.319944	24
37	9.680288	386	9.943417	115	9.736871	501	10.263129	10.056583	10.319712	23
38	9.680519	385	9.943348	115	9.737171	500	10.262829	10.056652	10.319481	22
39	9.680750	385	9.943279	115	9.737471	500	10.262529	10.056721	10.319250	21
40	9.680982	385	9.943210	115	9.737771	500	10.262229	10.056790	10.319018	20
41	9.681213	385	9.943141	115	9.738071	500	10.261929	10.056859	10.318787	19
42	9.681443	384	9.943072	115	9.738371	500	10.261629	10.056928	10.318557	18
43	9.681674	384	9.943003	115	9.738671	500	10.261329	10.056997	10.318326	17
44	9.681905	384	9.942934	115	9.738971	499	10.261029	10.057066	10.318095	16
45	9.682135	384	9.942864	115	9.739271	499	10.260729	10.057136	10.317865	15
46	9.682365	383	9.942795	116	9.739570	499	10.260430	10.057205	10.317635	14
47	9.682595	383	9.942726	116	9.739870	499	10.260130	10.057274	10.317405	13
48	9.682825	383	9.942656	116	9.740169	499	10.259831	10.057344	10.317175	12
49	9.683055	383	9.942587	116	9.740468	498	10.259532	10.057413	10.316945	11
50	9.683284	382	9.942517	116	9.740767	498	10.259233	10.057483	10.316716	10
51	9.683514	382	9.942448	116	9.741066	498	10.258934	10.057552	10.316486	9
52	9.683743	382	9.942378	116	9.741365	498	10.258635	10.057622	10.316257	8
53	9.683972	382	9.942308	116	9.741664	498	10.258336	10.057692	10.316028	7
54	9.684201	381	9.942239	116	9.741962	498	10.258038	10.057761	10.315799	6
55	9.684430	381	9.942169	116	9.742261	497	10.257739	10.057831	10.315570	5
56	9.684658	381	9.942099	116	9.742559	497	10.257441	10.057901	10.315342	4
57	9.684887	380	9.942029	116	9.742858	497	10.257142	10.057971	10.315113	3
58	9.685115	380	9.941959	116	9.743156	497	10.256844	10.058041	10.314885	2
59	9.685343	380	9.941889	117	9.743454	497	10.256546	10.058111	10.314657	1
60	9.685571		9.941819		9.743752		10.256248	10.058181	10.314429	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

61 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

29 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.685571	380	9.941819	117	9.743752	496	10.256248	10.058181	10.314429	60
1	9.685799	379	9.941749	117	9.744050	496	10.255950	10.058251	10.314201	59
2	9.686027	379	9.941679	117	9.744348	496	10.255652	10.058321	10.313973	58
3	9.686254	379	9.941609	117	9.744645	496	10.255355	10.058391	10.313746	57
4	9.686482	379	9.941539	117	9.744943	496	10.255057	10.058461	10.313518	56
5	9.686709	378	9.941469	117	9.745240	496	10.254760	10.058531	10.313291	55
6	9.686936	378	9.941398	117	9.745538	495	10.254462	10.058602	10.313064	54
7	9.687163	378	9.941328	117	9.745835	495	10.254165	10.058672	10.312837	53
8	9.687389	378	9.941258	117	9.746132	495	10.253868	10.058742	10.312611	52
9	9.687616	377	9.941187	117	9.746129	495	10.253571	10.058813	10.312384	51
10	9.687843	377	9.941117	117	9.746726	495	10.253274	10.058883	10.312157	50
11	9.688069	377	9.941046	118	9.747023	494	10.252977	10.058954	10.311931	49
12	9.688295	377	9.940975	118	9.747319	494	10.252681	10.059025	10.311705	48
13	9.688521	376	9.940905	118	9.747616	494	10.252384	10.059095	10.311479	47
14	9.688747	376	9.940834	118	9.747913	494	10.252087	10.059166	10.311253	46
15	9.688972	376	9.940763	118	9.748209	494	10.251791	10.059237	10.311028	45
16	9.689198	376	9.940693	118	9.748505	494	10.251495	10.059307	10.310802	44
17	9.689423	375	9.940622	118	9.748801	493	10.251199	10.059378	10.310577	43
18	9.689648	375	9.940551	118	9.749097	493	10.250903	10.059449	10.310352	42
19	9.689873	375	9.940480	118	9.749393	493	10.250607	10.059520	10.310127	41
20	9.690098	375	9.940409	118	9.749689	493	10.250311	10.059591	10.309902	40
21	9.690323	374	9.940338	118	9.749985	493	10.250015	10.059662	10.309677	39
22	9.690548	374	9.940267	118	9.750281	493	10.249719	10.059733	10.309452	38
23	9.690772	374	9.940196	118	9.750576	492	10.249424	10.059804	10.309228	37
24	9.690996	374	9.940125	119	9.750872	492	10.249128	10.059875	10.309004	36
25	9.691220	373	9.940054	119	9.751167	492	10.248833	10.059946	10.308780	35
26	9.691444	373	9.939982	119	9.751462	492	10.248538	10.060018	10.308556	34
27	9.691668	373	9.939911	119	9.751757	492	10.248243	10.060089	10.308332	33
28	9.691892	373	9.939840	119	9.752052	491	10.247948	10.060160	10.308108	32
29	9.692115	372	9.939768	119	9.752347	491	10.247653	10.060232	10.307885	31
30	9.692339	372	9.939697	119	9.752642	491	10.247358	10.060303	10.307661	30
31	9.692562	372	9.939625	119	9.752937	491	10.247063	10.060375	10.307438	29
32	9.692785	371	9.939554	119	9.753231	491	10.246769	10.060446	10.307215	28
33	9.693008	371	9.939482	119	9.753526	491	10.246474	10.060518	10.306992	27
34	9.693231	371	9.939410	119	9.753820	490	10.246180	10.060590	10.306769	26
35	9.693453	371	9.939339	119	9.754115	490	10.245885	10.060661	10.306547	25
36	9.693676	370	9.939267	120	9.754409	490	10.245591	10.060733	10.306324	24
37	9.693898	370	9.939195	120	9.754703	490	10.245297	10.060805	10.306102	23
38	9.694120	370	9.939123	120	9.754997	490	10.245003	10.060877	10.305880	22
39	9.694342	370	9.939052	120	9.755291	490	10.244709	10.060948	10.305658	21
40	9.694564	369	9.938980	120	9.755585	489	10.244415	10.061020	10.305436	20
41	9.694786	369	9.938908	120	9.755878	489	10.244122	10.061092	10.305214	19
42	9.695007	369	9.938836	120	9.756172	489	10.243828	10.061164	10.304993	18
43	9.695229	369	9.938763	120	9.756465	489	10.243535	10.061237	10.304771	17
44	9.695450	368	9.938691	120	9.756759	489	10.243241	10.061309	10.304550	16
45	9.695671	368	9.938619	120	9.757052	489	10.242948	10.061381	10.304329	15
46	9.695892	368	9.938547	120	9.757345	488	10.242655	10.061453	10.304108	14
47	9.696113	368	9.938475	120	9.757638	488	10.242362	10.061525	10.303887	13
48	9.696334	367	9.938402	121	9.757931	488	10.242069	10.061598	10.303666	12
49	9.696554	367	9.938330	121	9.758224	488	10.241776	10.061670	10.303446	11
50	9.696775	367	9.938258	121	9.758517	488	10.241483	10.061742	10.303225	10
51	9.696995	367	9.938185	121	9.758810	488	10.241190	10.061815	10.303005	9
52	9.697215	366	9.938113	121	9.759102	487	10.240898	10.061887	10.302785	8
53	9.697435	366	9.938040	121	9.759395	487	10.240605	10.061960	10.302565	7
54	9.697654	366	9.937967	121	9.759687	487	10.240313	10.062033	10.302346	6
55	9.697874	366	9.937895	121	9.759979	487	10.240021	10.062105	10.302126	5
56	9.698094	365	9.937822	121	9.760272	487	10.239728	10.062178	10.301906	4
57	9.698313	365	9.937749	121	9.760564	487	10.239436	10.062251	10.301687	3
58	9.698532	365	9.937676	121	9.760856	486	10.239144	10.062324	10.301468	2
59	9.698751	365	9.937604	121	9.761148	486	10.238852	10.062396	10.301249	1
60	9.698970		9.937531		9.761439		10.238561	10.062469	10.301030	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

60 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

30 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.698970	364	9.937531	121	9.761439	486	10.238561	10.062469	10.301030	60
1	9.699189	364	9.937458	122	9.761731	486	10.238269	10.062542	10.300811	59
2	9.699407	364	9.937385	122	9.762023	486	10.237977	10.062615	10.300593	58
3	9.699626	364	9.937312	122	9.762314	486	10.237686	10.062688	10.300374	57
4	9.699844	363	9.937238	122	9.762606	485	10.237394	10.062762	10.300156	56
5	9.700062	363	9.937165	122	9.762897	485	10.237103	10.062835	10.299938	55
6	9.700280	363	9.937092	122	9.763188	485	10.236812	10.062908	10.299720	54
7	9.700498	363	9.937019	122	9.763479	485	10.236521	10.062981	10.299502	53
8	9.700716	363	9.936946	122	9.763770	485	10.236230	10.063054	10.299284	52
9	9.700933	362	9.936872	122	9.764061	485	10.235939	10.063128	10.299067	51
10	9.701151	362	9.936799	122	9.764352	485	10.235648	10.063201	10.298849	50
11	9.701368	362	9.936725	122	9.764643	484	10.235357	10.063275	10.298632	49
12	9.701585	362	9.936652	123	9.764933	484	10.235067	10.063348	10.298415	48
13	9.701802	361	9.936578	123	9.765224	484	10.234776	10.063422	10.298198	47
14	9.702019	361	9.936505	123	9.765514	484	10.234486	10.063495	10.297981	46
15	9.702236	361	9.936431	123	9.765805	484	10.234195	10.063569	10.297764	45
16	9.702452	361	9.936357	123	9.766095	484	10.233905	10.063643	10.297548	44
17	9.702669	360	9.936284	123	9.766385	483	10.233615	10.063716	10.297331	43
18	9.702885	360	9.936210	123	9.766675	483	10.233325	10.063790	10.297115	42
19	9.703101	360	9.936136	123	9.766965	483	10.233035	10.063864	10.296899	41
20	9.703317	360	9.936062	123	9.767255	483	10.232745	10.063938	10.296683	40
21	9.703533	359	9.935988	123	9.767545	483	10.232455	10.064012	10.296467	39
22	9.703749	359	9.935914	123	9.767834	483	10.232166	10.064086	10.296251	38
23	9.703964	359	9.935840	123	9.768124	482	10.231876	10.064160	10.296036	37
24	9.704179	359	9.935766	124	9.768414	482	10.231586	10.064234	10.295821	36
25	9.704395	359	9.935692	124	9.768703	482	10.231297	10.064308	10.295605	35
26	9.704610	358	9.935618	124	9.768992	482	10.231008	10.064382	10.295390	34
27	9.704825	358	9.935543	124	9.769281	482	10.230719	10.064457	10.295175	33
28	9.705040	358	9.935469	124	9.769570	482	10.230430	10.064531	10.294960	32
29	9.705254	358	9.935395	124	9.769860	481	10.230140	10.064605	10.294746	31
30	9.705469	357	9.935320	124	9.770148	481	10.229852	10.064680	10.294531	30
31	9.705683	357	9.935246	124	9.770437	481	10.229563	10.064754	10.294317	29
32	9.705898	357	9.935171	124	9.770726	481	10.229274	10.064829	10.294102	28
33	9.706112	357	9.935097	124	9.771015	481	10.228985	10.064903	10.293888	27
34	9.706326	356	9.935022	124	9.771303	481	10.228697	10.064978	10.293674	26
35	9.706539	356	9.934948	124	9.771592	481	10.228408	10.065052	10.293461	25
36	9.706753	356	9.934873	124	9.771880	480	10.228120	10.065127	10.293247	24
37	9.706967	356	9.934798	125	9.772168	480	10.227832	10.065202	10.293033	23
38	9.707180	355	9.934723	125	9.772457	480	10.227543	10.065277	10.292820	22
39	9.707393	355	9.934649	125	9.772745	480	10.227255	10.065351	10.292607	21
40	9.707606	355	9.934574	125	9.773033	480	10.226967	10.065426	10.292394	20
41	9.707819	355	9.934499	125	9.773321	480	10.226679	10.065501	10.292181	19
42	9.708032	354	9.934424	125	9.773608	480	10.226392	10.065576	10.291968	18
43	9.708245	354	9.934349	125	9.773896	479	10.226104	10.065651	10.291755	17
44	9.708458	354	9.934274	125	9.774184	479	10.225816	10.065726	10.291542	16
45	9.708670	354	9.934199	125	9.774471	479	10.225529	10.065801	10.291330	15
46	9.708882	353	9.934123	125	9.774759	479	10.225241	10.065877	10.291118	14
47	9.709094	353	9.934048	125	9.775046	479	10.224954	10.065952	10.290906	13
48	9.709306	353	9.933973	125	9.775333	479	10.224667	10.066027	10.290691	12
49	9.709518	353	9.933898	126	9.775621	478	10.224379	10.066102	10.290482	11
50	9.709730	353	9.933822	126	9.775908	478	10.224092	10.066178	10.290270	10
51	9.709941	352	9.933747	126	9.776195	478	10.223805	10.066253	10.290059	9
52	9.710153	352	9.933671	126	9.776482	478	10.223518	10.066329	10.289847	8
53	9.710364	352	9.933596	126	9.776769	478	10.223231	10.066404	10.289636	7
54	9.710575	352	9.933520	126	9.777055	478	10.222945	10.066480	10.289425	6
55	9.710786	351	9.933445	126	9.777342	478	10.222658	10.066555	10.289214	5
56	9.710997	351	9.933369	126	9.777628	477	10.222372	10.066631	10.289003	4
57	9.711208	351	9.933293	126	9.777915	477	10.222085	10.066707	10.288792	3
58	9.711419	351	9.933217	126	9.778201	477	10.221799	10.066783	10.288581	2
59	9.711629	350	9.933141	126	9.778487	477	10.221513	10.066859	10.288371	1
60	9.711839		9.933066		9.778774		10.221226	10.066934	10.288161	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

59 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

31 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.711839	350	9.933066	126	9.778774	477	10.221226	10.066934	10.288161	60
1	9.712050	350	9.932990	127	9.779060	477	10.220940	10.067010	10.287950	59
2	9.712260	350	9.932914	127	9.779346	477	10.220654	10.067086	10.287740	58
3	9.712469	349	9.932838	127	9.779632	476	10.220368	10.067162	10.287531	57
4	9.712679	349	9.932762	127	9.779918	476	10.220082	10.067238	10.287321	56
5	9.712889	349	9.932685	127	9.780203	476	10.219797	10.067315	10.287111	55
6	9.713098	349	9.932609	127	9.780489	476	10.219511	10.067391	10.286902	54
7	9.713308	349	9.932533	127	9.780775	476	10.219225	10.067467	10.286692	53
8	9.713517	348	9.932457	127	9.781060	476	10.218940	10.067543	10.286483	52
9	9.713726	348	9.932380	127	9.781346	476	10.218654	10.067620	10.286274	51
10	9.713935	348	9.932304	127	9.781631	475	10.218369	10.067696	10.286065	50
11	9.714144	348	9.932228	127	9.781916	475	10.218084	10.067772	10.285856	49
12	9.714352	347	9.932151	127	9.782201	475	10.217799	10.067849	10.285648	48
13	9.714561	347	9.932075	128	9.782486	475	10.217514	10.067925	10.285439	47
14	9.714769	347	9.931998	128	9.782771	475	10.217229	10.068002	10.285231	46
15	9.714978	347	9.931921	128	9.783056	475	10.216944	10.068079	10.285022	45
16	9.715186	347	9.931845	128	9.783341	475	10.216659	10.068155	10.284814	44
17	9.715394	346	9.931768	128	9.783626	474	10.216374	10.068232	10.284606	43
18	9.715602	346	9.931691	128	9.783910	474	10.216090	10.068309	10.284398	42
19	9.715809	346	9.931614	128	9.784195	474	10.215805	10.068386	10.284191	41
20	9.716017	346	9.931537	128	9.784479	474	10.215521	10.068463	10.283983	40
21	9.716224	345	9.931460	128	9.784764	474	10.215236	10.068540	10.283776	39
22	9.716432	345	9.931383	128	9.785048	474	10.214952	10.068617	10.283568	38
23	9.716639	345	9.931306	128	9.785332	474	10.214668	10.068694	10.283361	37
24	9.716846	345	9.931229	129	9.785616	473	10.214384	10.068771	10.283154	36
25	9.717053	345	9.931152	129	9.785900	473	10.214100	10.068848	10.282947	35
26	9.717259	344	9.931075	129	9.786184	473	10.213816	10.068925	10.282741	34
27	9.717466	344	9.930998	129	9.786468	473	10.213532	10.069002	10.282534	33
28	9.717673	344	9.930921	129	9.786752	473	10.213248	10.069079	10.282327	32
29	9.717879	344	9.930843	129	9.787036	473	10.212964	10.069157	10.282121	31
30	9.718085	343	9.930766	129	9.787319	473	10.212681	10.069234	10.281915	30
31	9.718291	343	9.930688	129	9.787603	472	10.212397	10.069312	10.281709	29
32	9.718497	343	9.930611	129	9.787886	472	10.212114	10.069389	10.281503	28
33	9.718703	343	9.930533	129	9.788170	472	10.211830	10.069467	10.281297	27
34	9.718909	343	9.930456	129	9.788453	472	10.211547	10.069544	10.281091	26
35	9.719114	342	9.930378	129	9.788736	472	10.211264	10.069622	10.280886	25
36	9.719320	342	9.930300	130	9.789019	472	10.210981	10.069700	10.280680	24
37	9.719525	342	9.930223	130	9.789302	472	10.210698	10.069777	10.280475	23
38	9.719730	342	9.930145	130	9.789585	471	10.210415	10.069855	10.280270	22
39	9.719935	341	9.930067	130	9.789868	471	10.210132	10.069933	10.280065	21
40	9.720140	341	9.929989	130	9.790151	471	10.209849	10.070011	10.279860	20
41	9.720345	341	9.929911	130	9.790433	471	10.209567	10.070089	10.279655	19
42	9.720549	341	9.929833	130	9.790716	471	10.209284	10.070167	10.279451	18
43	9.720754	340	9.929755	130	9.790999	471	10.209001	10.070245	10.270246	17
44	9.720958	340	9.929677	130	9.791281	471	10.208719	10.070323	10.279042	16
45	9.721162	340	9.929599	130	9.791563	470	10.208437	10.070401	10.278838	15
46	9.721366	340	9.929521	130	9.791846	470	10.208154	10.070479	10.278634	14
47	9.721570	340	9.929442	130	9.792128	470	10.207872	10.070558	10.278430	13
48	9.721774	339	9.929364	131	9.792410	470	10.207590	10.070636	10.278226	12
49	9.721978	339	9.929286	131	9.792692	470	10.207308	10.070714	10.278022	11
50	9.722181	339	9.929207	131	9.792974	470	10.207026	10.070793	10.277819	10
51	9.722385	339	9.929129	131	9.793256	470	10.206744	10.070871	10.277615	9
52	9.722588	339	9.929050	131	9.793538	469	10.206462	10.070950	10.277412	8
53	9.722791	338	9.928972	131	9.793819	469	10.206181	10.071028	10.277209	7
54	9.722994	338	9.928893	131	9.794101	469	10.205899	10.071107	10.277006	6
55	9.723197	338	9.928815	131	9.794383	469	10.205617	10.071185	10.276803	5
56	9.723400	338	9.928736	131	9.794664	469	10.205336	10.071264	10.276600	4
57	9.723603	337	9.928657	131	9.794945	469	10.205055	10.071343	10.276397	3
58	9.723805	337	9.928578	131	9.795227	469	10.204773	10.071422	10.276195	2
59	9.724007	337	9.928499	131	9.795508	468	10.204492	10.071501	10.275993	1
60	9.724210		9.928420		9.795789		10.204211	10.071580	10.275790	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

58 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

32 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.724210	337	9.928420	132	9.795789	468	10.204211	10.071580	10.275790	60
1	9.724412	337	9.928342	132	9.796070	468	10.203930	10.071658	10.275588	59
2	9.724614	336	9.928263	132	9.796351	468	10.203649	10.071737	10.275386	58
3	9.724816	336	9.928183	132	9.796632	468	10.203368	10.071817	10.275184	57
4	9.725017	336	9.928104	132	9.796913	468	10.203087	10.071896	10.274983	56
5	9.725219	336	9.928025	132	9.797194	468	10.202806	10.071975	10.274781	55
6	9.725420	335	9.927946	132	9.797475	468	10.202525	10.072054	10.274580	54
7	9.725622	335	9.927867	132	9.797755	467	10.202245	10.072133	10.274378	53
8	9.725823	335	9.927787	132	9.798036	467	10.201964	10.072213	10.274177	52
9	9.726024	335	9.927708	132	9.798316	467	10.201684	10.072292	10.273976	51
10	9.726225	335	9.927629	132	9.798596	467	10.201404	10.072371	10.273775	50
11	9.726426	334	9.927549	132	9.798877	467	10.201123	10.072451	10.273574	49
12	9.726626	334	9.927470	133	9.799157	467	10.200843	10.072530	10.273374	48
13	9.726827	334	9.927390	133	9.799437	467	10.200563	10.072610	10.273173	47
14	9.727027	334	9.927310	133	9.799717	467	10.200283	10.072690	10.272973	46
15	9.727228	334	9.927231	133	9.799997	466	10.200003	10.072769	10.272772	45
16	9.727428	333	9.927151	133	9.800277	466	10.199723	10.072849	10.272572	44
17	9.727628	333	9.927071	133	9.800557	466	10.199443	10.072929	10.272372	43
18	9.727828	333	9.926991	133	9.800836	466	10.199164	10.073009	10.272172	42
19	9.728027	333	9.926911	133	9.801116	466	10.198884	10.073089	10.271973	41
20	9.728227	333	9.926831	133	9.801396	466	10.198604	10.073169	10.271773	40
21	9.728427	332	9.926751	133	9.801675	466	10.198325	10.073249	10.271573	39
22	9.728626	332	9.926671	133	9.801955	466	10.198045	10.073329	10.271374	38
23	9.728825	332	9.926591	133	9.802234	465	10.197766	10.073409	10.271175	37
24	9.729024	332	9.926511	134	9.802513	465	10.197487	10.073489	10.270976	36
25	9.729223	331	9.926431	134	9.802792	465	10.197208	10.073569	10.270777	35
26	9.729422	331	9.926351	134	9.803072	465	10.196928	10.073649	10.270578	34
27	9.729621	331	9.926270	134	9.803351	465	10.196649	10.073730	10.270379	33
28	9.729820	331	9.926190	134	9.803630	465	10.196370	10.073810	10.270180	32
29	9.730018	330	9.926110	134	9.803908	465	10.196092	10.073890	10.269982	31
30	9.730217	330	9.926029	134	9.804187	465	10.195813	10.073971	10.269783	30
31	9.730415	330	9.925949	134	9.804466	464	10.195534	10.074051	10.269585	29
32	9.730613	330	9.925868	134	9.804745	464	10.195255	10.074132	10.269387	28
33	9.730811	330	9.925788	134	9.805023	464	10.194977	10.074212	10.269189	27
34	9.731009	329	9.925707	134	9.805302	464	10.194698	10.074293	10.268991	26
35	9.731206	329	9.925626	134	9.805580	464	10.194420	10.074374	10.268794	25
36	9.731404	329	9.925545	135	9.805859	464	10.194141	10.074455	10.268596	24
37	9.731602	329	9.925465	135	9.806137	464	10.193863	10.074535	10.268398	23
38	9.731799	329	9.925384	135	9.806415	464	10.193585	10.074616	10.268201	22
39	9.731996	328	9.925303	135	9.806693	463	10.193307	10.074697	10.268004	21
40	9.732193	328	9.925222	135	9.806971	463	10.193029	10.074778	10.267807	20
41	9.732390	328	9.925141	135	9.807249	463	10.192751	10.074859	10.267610	19
42	9.732587	328	9.925060	135	9.807527	463	10.192473	10.074940	10.267413	18
43	9.732784	328	9.924979	135	9.807805	463	10.192195	10.075021	10.267216	17
44	9.732980	327	9.924897	135	9.808083	463	10.191917	10.075103	10.267020	16
45	9.733177	327	9.924816	135	9.808361	463	10.191639	10.075184	10.266823	15
46	9.733373	327	9.924735	136	9.808638	463	10.191362	10.075265	10.266627	14
47	9.733569	327	9.924654	136	9.808916	462	10.191084	10.075346	10.266131	13
48	9.733765	327	9.924572	136	9.809193	462	10.190807	10.075428	10.266235	12
49	9.733961	326	9.924491	136	9.809471	462	10.190529	10.075509	10.266039	11
50	9.734157	326	9.924409	136	9.809748	462	10.190252	10.075591	10.265843	10
51	9.734353	326	9.924328	136	9.810025	462	10.189975	10.075672	10.265647	9
52	9.734549	326	9.924246	136	9.810302	462	10.189698	10.075754	10.265451	8
53	9.734744	325	9.924164	136	9.810580	462	10.189420	10.075836	10.265256	7
54	9.734939	325	9.924083	136	9.810857	462	10.189143	10.075917	10.265061	6
55	9.735135	325	9.924001	136	9.811134	461	10.188866	10.075999	10.264865	5
56	9.735330	325	9.923919	136	9.811410	461	10.188590	10.076081	10.264670	4
57	9.735525	325	9.923837	136	9.811687	461	10.188313	10.076163	10.264475	3
58	9.735719	324	9.923755	137	9.811964	461	10.188036	10.076245	10.264281	2
59	9.735914	324	9.923673	137	9.812241	461	10.187759	10.076327	10.264086	1
60	9.736109		9.923591		9.812517		10.187483	10.076409	10.263891	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

57 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

33 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.736109	324	9.923591	137	9.812517	461	10.187483	10.076409	10.263891	60
1	9.736303	324	9.923509	137	9.812794	461	10.187206	10.076491	10.263697	59
2	9.736498	324	9.923427	137	9.813070	461	10.186930	10.076573	10.263502	58
3	9.736692	323	9.923345	137	9.813347	460	10.186653	10.076655	10.263308	57
4	9.736886	323	9.923263	137	9.813623	460	10.186377	10.076737	10.263114	56
5	9.737080	323	9.923181	137	9.813899	460	10.186101	10.076819	10.262920	55
6	9.737274	323	9.923098	137	9.814175	460	10.185825	10.076902	10.262726	54
7	9.737467	323	9.923016	137	9.814452	460	10.185548	10.076984	10.262533	53
8	9.737661	322	9.922933	137	9.814728	460	10.185272	10.077067	10.262339	52
9	9.737855	322	9.922851	137	9.815004	460	10.184996	10.077149	10.262145	51
10	9.738048	322	9.922768	138	9.815279	460	10.184721	10.077232	10.261952	50
11	9.738241	322	9.922686	138	9.815555	460	10.184445	10.077314	10.261759	49
12	9.738434	322	9.922603	138	9.815831	459	10.184169	10.077397	10.261566	48
13	9.738627	321	9.922520	138	9.816107	459	10.183893	10.077480	10.261373	47
14	9.738820	321	9.922438	138	9.816382	459	10.183618	10.077562	10.261180	46
15	9.739013	321	9.922355	138	9.816658	459	10.183342	10.077645	10.260987	45
16	9.739206	321	9.922272	138	9.816933	459	10.183067	10.077728	10.260794	44
17	9.739398	321	9.922189	138	9.817209	459	10.182791	10.077811	10.260602	43
18	9.739590	320	9.922106	138	9.817484	459	10.182516	10.077894	10.260410	42
19	9.739783	320	9.922023	138	9.817759	459	10.182241	10.077977	10.260217	41
20	9.739975	320	9.921940	138	9.818035	459	10.181965	10.078060	10.260025	40
21	9.740167	320	9.921857	139	9.818310	458	10.181690	10.078143	10.259833	39
22	9.740359	320	9.921774	139	9.818585	458	10.181415	10.078226	10.259641	38
23	9.740550	319	9.921691	139	9.818860	458	10.181140	10.078309	10.259450	37
24	9.740742	319	9.921607	139	9.819135	458	10.180865	10.078393	10.259258	36
25	9.740934	319	9.921524	139	9.819410	458	10.180590	10.078476	10.259066	35
26	9.741125	319	9.921441	139	9.819684	458	10.180316	10.078559	10.258875	34
27	9.741316	319	9.921357	139	9.819959	458	10.180041	10.078643	10.258684	33
28	9.741508	318	9.921274	139	9.820234	458	10.179766	10.078726	10.258492	32
29	9.741699	318	9.921190	139	9.820508	458	10.179492	10.078810	10.258301	31
30	9.741889	318	9.921107	139	9.820783	457	10.179217	10.078893	10.258111	30
31	9.742080	318	9.921023	139	9.821057	457	10.178943	10.078977	10.257920	29
32	9.742271	318	9.920939	139	9.821332	457	10.178668	10.079061	10.257729	28
33	9.742462	317	9.920856	140	9.821606	457	10.178394	10.079144	10.257538	27
34	9.742652	317	9.920772	140	9.821880	457	10.178120	10.079228	10.257348	26
35	9.742842	317	9.920688	140	9.822154	457	10.177846	10.079312	10.257158	25
36	9.743033	317	9.920604	140	9.822429	457	10.177571	10.079396	10.256967	24
37	9.743223	317	9.920520	140	9.822703	457	10.177297	10.079480	10.256777	23
38	9.743413	316	9.920436	140	9.822977	457	10.177023	10.079564	10.256587	22
39	9.743602	316	9.920352	140	9.823250	456	10.176750	10.079648	10.256398	21
40	9.743792	316	9.920268	140	9.823524	456	10.176476	10.079732	10.256208	20
41	9.743982	316	9.920184	140	9.823798	456	10.176202	10.079816	10.256018	19
42	9.744171	316	9.920099	140	9.824072	456	10.175928	10.079901	10.255829	18
43	9.744361	315	9.920015	140	9.824345	456	10.175655	10.079985	10.255639	17
44	9.744550	315	9.919931	141	9.824619	456	10.175381	10.080069	10.255450	16
45	9.744739	315	9.919846	141	9.824893	456	10.175107	10.080154	10.255261	15
46	9.744928	315	9.919762	141	9.825166	456	10.174834	10.080238	10.255072	14
47	9.745117	315	9.919677	141	9.825439	456	10.174561	10.080323	10.254883	13
48	9.745306	314	9.919593	141	9.825713	455	10.174287	10.080407	10.254694	12
49	9.745494	314	9.919508	141	9.825986	455	10.174014	10.080492	10.254506	11
50	9.745683	314	9.919424	141	9.826259	455	10.173741	10.080576	10.254317	10
51	9.745871	314	9.919339	141	9.826532	455	10.173468	10.080661	10.254129	9
52	9.746060	314	9.919254	141	9.826805	455	10.173195	10.080746	10.253940	8
53	9.746248	313	9.919169	141	9.827078	455	10.172922	10.080831	10.253752	7
54	9.746436	313	9.919085	141	9.827351	455	10.172649	10.080915	10.253564	6
55	9.746624	313	9.919000	142	9.827624	455	10.172376	10.081000	10.253376	5
56	9.746812	313	9.918915	142	9.827897	455	10.172103	10.081085	10.253188	4
57	9.746999	313	9.918830	142	9.828170	454	10.171830	10.081170	10.253001	3
58	9.747187	312	9.918745	142	9.828442	454	10.171558	10.081255	10.252813	2
59	9.747374	312	9.918659	142	9.828715	454	10.171285	10.081341	10.252626	1
60	9.747562		9.918574		9.828987		10.171013	10.081426	10.252438	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

56 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

34 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.747562	312	9.918574	142	9.828987	454	10.171013	10.081426	10.252438	60
1	9.747749	312	9.918489	142	9.829260	454	10.170740	10.081511	10.252251	59
2	9.747936	312	9.918404	142	9.829532	454	10.170468	10.081596	10.252064	58
3	9.748123	311	9.918318	142	9.829805	454	10.170195	10.081682	10.251877	57
4	9.748310	311	9.918233	142	9.830077	454	10.169923	10.081767	10.251690	56
5	9.748497	311	9.918147	142	9.830349	454	10.169651	10.081853	10.251503	55
6	9.748683	311	9.918062	143	9.830621	453	10.169379	10.081938	10.251317	54
7	9.748870	311	9.917976	143	9.830893	453	10.169107	10.082024	10.251130	53
8	9.749056	310	9.917891	143	9.831165	453	10.168835	10.082109	10.250944	52
9	9.749243	310	9.917805	143	9.831437	453	10.168563	10.082195	10.250757	51
10	9.749429	310	9.917719	143	9.831709	453	10.168291	10.082281	10.250571	50
11	9.749615	310	9.917634	143	9.831981	453	10.168019	10.082366	10.250385	49
12	9.749801	310	9.917548	143	9.832253	453	10.167747	10.082152	10 250199	48
13	9.749987	309	9.917462	143	9.832525	453	10.167475	10.082538	10.250013	47
14	9.750172	309	9.917376	143	9.832796	453	10.167204	10.082624	10.249828	46
15	9.750358	309	9.917290	143	9.833068	453	10.166932	10.082710	10.249642	45
16	9.750543	309	9.917204	143	9.833339	452	10.166661	10.082796	10.249457	44
17	9.750729	309	9.917118	144	9.833611	452	10.166389	10.082882	10.249271	43
18	9.750914	308	9.917032	144	9.833882	452	10.166118	10.082968	10.249086	42
19	9.751099	308	9.916946	144	9.834154	452	10.165846	10.083054	10.248901	41
20	9.751284	308	9.916859	144	9.834425	452	10.165575	10.083141	10.248716	40
21	9.751469	308	9.916773	144	9.834696	452	10.165304	10.083227	10.248531	39
22	9.751654	308	9.916687	144	9.834967	452	10.165033	10.083313	10.248346	38
23	9.751839	308	9.916600	144	9.835238	452	10.164762	10.083400	10.248161	37
24	9.752023	307	9.916514	144	9.835509	452	10.164491	10.083486	10.247977	36
25	9.752208	307	9.916427	144	9.835780	452	10.164220	10.083573	10.247792	35
26	9.752392	307	9.916341	144	9.836051	451	10.163949	10.083659	10.247608	34
27	9.752576	307	9.916254	144	9.836322	451	10.163678	10.083746	10.247424	33
28	9.752760	307	9.916167	145	9.836593	451	10.163407	10.083833	10.247240	32
29	9.752944	306	9.916081	145	9.836864	451	10.163136	10.083919	10.247056	31
30	9.753128	306	9.915994	145	9.837134	451	10.162866	10.084006	10.246872	30
31	9.753312	306	9.915907	145	9.837405	451	10.162595	10.084093	10.246688	29
32	9.753495	306	9.915820	145	9.837675	451	10.162325	10.084180	10.246505	28
33	9.753679	306	9.915733	145	9.837946	451	10.162054	10.084267	10.246321	27
34	9.753862	305	9.915646	145	9.838216	451	10.161784	10.084354	10.246138	26
35	9.754046	305	9.915559	145	9.838487	451	10.161513	10.084441	10.245954	25
36	9.754229	305	9.915472	145	9.838757	450	10.161243	10.084528	10.245771	24
37	9.754412	305	9.915385	145	9.839027	450	10.160973	10.084615	10.245588	23
38	9.754595	305	9.915297	145	9.839297	450	10.160703	10.084703	10.245405	22
39	9.754778	304	9.915210	145	9.839568	450	10.160432	10.084790	10.245222	21
40	9.754960	304	9.915123	146	9.839838	450	10.160162	10.084877	10.245040	20
41	9.755143	304	9.915035	146	9.840108	450	10.159892	10.084965	10.244857	19
42	9.755326	304	9.914948	146	9.840378	450	10.159622	10.085052	10.244674	18
43	9.755508	304	9.914860	146	9.840647	450	10.159353	10.085140	10.244492	17
44	9.755690	304	9.914773	146	9.840917	450	10.159083	10.085227	10.244310	16
45	9.755872	303	9.914685	146	9.841187	450	10.158813	10.085315	10.244128	15
46	9.756054	303	9.914598	146	9.841457	449	10.158543	10.085402	10.243946	14
47	9.756236	303	9.914510	146	9.841726	449	10.158274	10.085490	10.243764	13
48	9.756418	303	9.914422	146	9.841996	449	10.158004	10.085578	10.243582	12
49	9.756600	303	9.914334	146	9.842266	449	10.157734	10.085666	10.243400	11
50	9.756782	302	9.914246	147	9.842535	449	10.157465	10.085754	10.243218	10
51	9.756963	302	9.914158	147	9.842805	449	10.157195	10.085842	10.243037	9
52	9.757144	802	9.914070	147	9.843074	449	10.156926	10.085930	10.242856	8
53	9.757326	302	9.913982	147	9.843343	449	10.156657	10.086018	10.242674	7
54	9.757507	302	9.913894	147	9.843612	449	10.156388	10.086106	10.242493	6
55	9.757688	301	9.913806	147	9.843882	449	10.156118	10.086194	10.242312	5
56	9.757869	301	9.913718	147	9.844151	448	10.155849	10.086282	10.242131	4
57	9.758050	301	9.913630	147	9.844420	448	10.155580	10.086370	10.241950	3
58	9.758230	301	9.913541	147	9.844689	448	10.155311	10.086459	10.241770	2
59	9.758411	301	9.913453	147	9.844958	448	10.155042	10.086547	10.241589	1
60	9.758591		9.913365		9.845227		10.154773	10.086635	10.241409	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

55 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

35 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.758591	301	9.913365	147	9.845227	448	10.154773	10.086635	10.241409	60
1	9.758772	300	9.913276	147	9.845496	448	10.154504	10.086724	10.241228	59
2	9.758952	300	9.913187	148	9.845764	448	10.154236	10.086813	10.241048	58
3	9.759132	300	9.913099	148	9.846033	448	10.153967	10.086901	10.240868	57
4	9.759312	300	9.913010	148	9.846302	448	10.153698	10.086990	10.240688	56
5	9.759492	300	9.912922	148	9.846570	448	10.153430	10.087078	10.240508	55
6	9.759672	299	9.912833	148	9.846839	448	10.153161	10.087167	10.240328	54
7	9.759852	299	9.912744	148	9.847107	447	10.152893	10.087256	10.240148	53
8	9.760031	299	9.912655	148	9.847376	447	10.152624	10.087345	10.239969	52
9	9.760211	299	9.912566	148	9.847644	447	10.152356	10.087434	10.239789	51
10	9.760390	299	9.912477	148	9.847913	447	10.152087	10.087523	10.239610	50
11	9.760569	298	9.912388	148	9.848181	447	10.151819	10.087612	10.239431	49
12	9.760748	298	9.912299	149	9.848449	447	10.151551	10.087701	10.239252	48
13	9.760927	298	9.912210	149	9.848717	447	10.151283	10.087790	10.239073	47
14	9.761106	298	9.912121	149	9.848986	447	10.151014	10.087879	10.238894	46
15	9.761285	298	9.912031	149	9.849254	447	10.150746	10.087969	10.238715	45
16	9.761464	298	9.911942	149	9.849522	447	10.150478	10.088058	10.238536	44
17	9.761642	297	9.911853	149	9.849790	446	10.150210	10.088147	10.238358	43
18	9.761821	297	9.911763	149	9.850058	446	10.149942	10.088237	10.238179	42
19	9.761999	297	9.911674	149	9.850325	446	10.149675	10.088326	10.238001	41
20	9.762177	297	9.911584	149	9.850593	446	10.149407	10.088416	10.237823	40
21	9.762356	297	9.911495	149	9.850861	446	10.149139	10.088505	10.237644	39
22	9.762534	296	9.911405	149	9.851129	446	10.148871	10.088595	10.237466	38
23	9.762712	296	9.911315	150	9.851396	446	10.148604	10.088685	10.237288	37
24	9.762889	296	9.911226	150	9.851664	446	10.148336	10.088774	10.237111	36
25	9.763067	296	9.911136	150	9.851931	446	10.148069	10.088864	10.236933	35
26	9.763245	296	9.911046	150	9.852199	446	10.147801	10.088954	10.236755	34
27	9.763422	296	9.910956	150	9.852466	446	10.147534	10.089044	10.236578	33
28	9.763600	295	9.910866	150	9.852733	445	10.147267	10.089134	10.236400	32
29	9.763777	295	9.910776	150	9.853001	445	10.146999	10.089224	10.236223	31
30	9.763954	295	9.910686	150	9.853268	445	10.146732	10.089314	10.236046	30
31	9.764131	295	9.910596	150	9.853535	445	10.146465	10.089404	10.235869	29
32	9.764308	295	9.910506	150	9.853802	445	10.146198	10.089494	10.235692	28
33	9.764485	294	9.910415	150	9.854069	445	10.145931	10.089585	10.235515	27
34	9.764662	294	9.910325	151	9.854336	445	10.145664	10.089675	10.235338	26
35	9.764838	294	9.910235	151	9.854603	445	10.145397	10.089765	10.235162	25
36	9.765015	294	9.910144	151	9.854870	445	10.145130	10.089856	10.234985	24
37	9.765191	294	9.910054	151	9.855137	445	10.144863	10.089946	10.234809	23
38	9.765367	294	9.909963	151	9.855404	445	10.144596	10.090037	10.234633	22
39	9.765544	293	9.909873	151	9.855671	444	10.144329	10.090127	10.234456	21
40	9.765720	293	9.909782	151	9.855938	444	10.144062	10.090218	10.234280	20
41	9.765896	293	9.909691	151	9.856204	444	10.143796	10.090309	10.234104	19
42	9.766072	293	9.909601	151	9.856471	444	10.143529	10.090399	10.233928	18
43	9.766247	293	9.909510	151	9.856737	444	10.143263	10.090490	10.233753	17
44	9.766423	293	9.909419	151	9.857004	444	10.142996	10.090581	10.233577	16
45	9.766598	292	9.909328	152	9.857270	444	10.142730	10.090672	10.233402	15
46	9.766774	292	9.909237	152	9.857537	444	10.142463	10.090763	10.233226	14
47	9.766949	292	9.909146	152	9.857803	444	10.142197	10.090854	10.233051	13
48	9.767124	292	9.909055	152	9.858069	444	10.141931	10.090945	10.232876	12
49	9.767300	292	9.908964	152	9.858336	444	10.141664	10.091036	10.232700	11
50	9.767475	291	9.908873	152	9.858602	444	10.141398	10.091127	10.232525	10
51	9.767649	291	9.908781	152	9.858868	443	10.141132	10.091219	10.232351	9
52	9.767824	291	9.908690	152	9.859134	443	10.140866	10.091310	10.232176	8
53	9.767999	291	9.908599	152	9.859400	443	10.140600	10.091401	10.232001	7
54	9.768173	291	9.908507	152	9.859666	443	10.140334	10.091493	10.231827	6
55	9.768348	290	9.908416	153	9.859932	443	10.140068	10.091584	10.231652	5
56	9.768522	290	9.908324	153	9.860198	443	10.139802	10.091676	10.231478	4
57	9.768697	290	9.908233	153	9.860464	443	10.139536	10.091767	10.231303	3
58	9.768871	290	9.908141	153	9.860730	443	10.139270	10.091859	10.231129	2
59	9.769045	290	9.908049	153	9.860995	443	10.139005	10.091951	10.230955	1
60	9.769219		9.907958		9.861261		10.138739	10.092042	10.230781	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

54 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

36 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.769219	290	9.907958	153	9.861261	443	10.138739	10.092042	10.230781	60
1	9.769393	289	9.907866	153	9.861527	443	10.138473	10.092134	10.230607	59
2	9.769566	289	9.907774	153	9.861792	443	10.138208	10.092226	10.230434	58
3	9.769740	289	9.907682	153	9.862058	442	10.137942	10.092318	10.230260	57
4	9.769913	289	9.907590	153	9.862323	442	10.137677	10.092410	10.230087	56
5	9.770087	289	9.907498	153	9.862589	442	10.137411	10.092502	10.229913	55
6	9 770260	288	9.907406	153	9.862854	442	10.137146	10.092594	10.229740	54
7	9.770433	288	9.907314	151	9.863119	442	10.136881	10.092686	10.229567	53
8	9.770606	288	9.907222	154	9.863385	442	10.136615	10.092778	10.229394	52
9	9.770779	288	9.907129	154	9.863650	442	10.136350	10.092871	10.229221	51
10	9.770952	288	9.907037	154	9.863915	442	10.136085	10.092963	10.229048	50
11	9.771125	288	9.906945	154	9.864180	442	10.135820	10.093055	10.228875	49
12	9.771298	287	9.906852	154	9.864445	442	10.135555	10.093148	10.228702	48
13	9.771470	287	9.906760	154	9.864710	442	10.135290	10.093240	10.228530	47
14	9.771643	287	9.906667	154	9.864975	442	10.135025	10.093333	10.228357	46
15	9.771815	287	9.906575	154	9.865240	441	10.134760	10.093425	10.228185	45
16	9.771987	287	9.906482	154	9.865505	441	10.134495	10.093518	10.228013	44
17	9.772159	287	9.906389	155	9.865770	441	10.134230	10.093611	10.227841	43
18	9.772331	286	9.906296	155	9.866035	441	10.133965	10.093704	10.227669	42
19	9.772503	286	9.906204	155	9.866300	441	10.133700	10.093796	10.227497	41
20	9.772675	286	9.906111	155	9.866564	441	10.133436	10.093889	10.227325	40
21	9.772847	286	9.906018	155	9.866829	441	10.133171	10.093982	10.227153	39
22	9.773018	286	9.905925	155	9.867094	441	10.132906	10.094075	10.226982	38
23	9.773190	286	9.905832	155	9.867358	441	10.132642	10.094168	10.226810	37
24	9.773361	285	9.905739	155	9.867623	441	10.132377	10.094261	10.226639	36
25	9.773533	285	9.905645	155	9.867887	441	10.132113	10.094355	10.226467	35
26	9.773704	285	9.905552	155	9.868152	441	10.131848	10.094448	10.226296	34
27	9.773875	285	9.905459	155	9.868416	441	10.131584	10.094541	10.226125	33
28	9.774046	285	9.905366	156	9.868680	440	10.131320	10.094634	10.225954	32
29	9.774217	285	9.905272	156	9.868945	440	10.131055	10.094728	10.225783	31
30	9.774388	284	9.905179	156	9.869209	440	10.130791	10.094821	10.225612	30
31	9.774558	284	9.905085	156	9.869473	440	10.130527	10.094915	10.225442	29
32	9.774729	284	9.904992	156	9.869737	440	10.130263	10.095008	10.225271	28
33	9.774899	284	9.904898	156	9.870001	440	10.129999	10.095102	10.225101	27
34	9.775070	284	9.904804	156	9.870265	440	10.129735	10.095196	10.224930	26
35	9.775240	284	9.904711	156	9.870529	440	10.129471	10.095289	10.224760	25
36	9.775410	283	9.904617	156	9.870793	440	10.129207	10.095383	10.224590	24
37	9.775580	283	9.904523	156	9.871057	440	10.128943	10.095477	10.224420	23
38	9.775750	283	9.904429	157	9.871321	440	10.128679	10.095571	10.224250	22
39	9.775920	283	9.904335	157	9.871585	440	10.128415	10.095665	10.224080	21
40	9.776090	283	9.904241	157	9.871849	440	10.128151	10.095759	10.223910	20
41	9.776259	283	9.904147	157	9.872112	439	10.127888	10.095853	10.223741	19
42	9.776429	282	9.904053	157	9.872376	439	10.127624	10.095947	10.223571	18
43	9.776598	282	9.903959	157	9.872640	439	10.127360	10.096041	10.223402	17
44	9.776768	282	9.903864	157	9.872903	439	10.127097	10.096136	10.223232	16
45	9.776937	282	9.903770	157	9.873167	439	10.126833	10.096230	10.223063	15
46	9.777106	282	9.903676	157	9.873430	439	10.126570	10.096324	10.222894	14
47	9.777275	281	9.903581	157	9.873694	439	10.126306	10.096419	10.222725	13
48	9.777444	281	9.903487	157	9.873957	439	10.126043	10.096513	10 222556	12
49	9.777613	281	9.903392	158	9.874220	439	10.125780	10.096608	10 222387	11
50	9.777781	281	9.903298	158	9.874484	439	10.125516	10.096702	10.222219	10
51	9.777950	281	9.903203	158	9.874747	439	10.125253	10.096797	10.222050	9
52	9.778119	281	9.903108	158	9.875010	439	10.124990	10.096892	10.221881	8
53	9.778287	280	9.903014	158	9.875273	439	10.124727	10.096986	10.221713	7
54	9.778455	280	9.902919	158	9.875536	439	10.124464	10.097081	10.221545	6
55	9.778624	280	9.902824	158	9.875800	438	10.124200	10.097176	10.221376	5
56	9.778792	280	9.902729	158	9.876063	438	10.123937	10.097271	10.221208	4
57	9.778960	280	9.902634	158	9.876326	438	10.123674	10.097366	10.221040	3
58	9.779128	280	9.902539	159	9.876589	438	10.123411	10.097461	10.220872	2
59	9.779295	279	9.902444	159	9.876851	438	10.123149	10.097556	10.220705	1
60	9.779463		9.902349		9.877114		10.122886	10.097651	10.220537	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

53 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

37 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.779463	279	9.902349	159	9.877114	438	10.122886	10.097651	10.220537	60
1	9.779631	279	9.902253	159	9.877377	438	10.122623	10.097747	10.220369	59
2	9.779798	279	9.902158	159	9.877640	438	10.122360	10.097842	10.220202	58
3	9.779966	279	9.902063	159	9.877903	438	10.122097	10.097937	10.220034	57
4	9.780133	279	9.901967	159	9.878165	438	10.121835	10.098033	10.219867	56
5	9.780300	278	9.901872	159	9.878428	438	10.121572	10.098128	10.219700	55
6	9.780467	278	9.901776	159	9.878691	438	10.121309	10.098224	10.219533	54
7	9.780634	278	9.901681	159	9.878953	437	10.121047	10.098319	10.219366	53
8	9.780801	278	9.901585	159	9.879216	437	10.120784	10.098415	10.219199	52
9	9.780968	278	9.901490	159	9.879478	437	10.120522	10.098510	10.219032	51
10	9.781134	278	9.901394	160	9.879741	437	10.120259	10.098606	10.218866	50
11	9.781301	277	9.901298	160	9.880003	437	10.119997	10.098702	10.218699	49
12	9.781468	277	9.901202	160	9.880265	437	10.119735	10.098798	10.218532	48
13	9.781634	277	9.901106	160	9.880528	437	10.119472	10.098894	10.218366	47
14	9.781800	277	9.901010	160	9.880790	437	10.119210	10.098990	10.218200	46
15	9.781966	277	9.900914	160	9.881052	437	10.118948	10.099086	10.218034	45
16	9.782132	277	9.900818	160	9.881314	437	10.118686	10.099182	10.217868	44
17	9.782298	276	9.900722	160	9.881576	437	10.118424	10.099278	10.217702	43
18	9.782464	276	9.900626	169	9.881839	437	10.118161	10.099374	10.217536	42
19	9.782630	276	9.900529	160	9.882101	437	10.117899	10.099471	10.217370	41
20	9.782796	276	9.900433	161	9.882363	437	10.117637	10.099567	10.217201	40
21	9.782961	276	9.900337	161	9.882625	436	10.117375	10.099663	10.217039	39
22	9.783127	276	9.900240	161	9.882887	436	10.117113	10.099760	10.216873	38
23	9.783292	275	9.900144	161	9.883148	436	10.116852	10.099856	10.216708	37
24	9.783458	275	9.900047	161	9.883410	436	10.116590	10.099953	10.216542	36
25	9.783623	275	9.899951	161	9.883672	436	10.116328	10.100049	10.216377	35
26	9.783788	275	9.899854	161	9.883934	436	10.116066	10.100146	10.216212	34
27	9.783953	275	9.899757	161	9.884196	436	10.115804	10.100243	10.216047	33
28	9.784118	275	9.899660	161	9.884457	436	10.115543	10.100340	10.215882	32
29	9.784282	274	9.899564	161	9.884719	436	10.115281	10.100436	10.215718	31
30	9.784447	274	9.899467	162	9.884980	436	10.115020	10.100533	10.215553	30
31	9.784612	274	9.899370	162	9.885242	436	10.114758	10.100630	10.215388	29
32	9.784776	274	9.899273	162	9.885503	436	10.114497	10.100727	10.215224	28
33	9.784941	274	9.899176	162	9.885765	436	10.114235	10.100824	10.215059	27
34	9.785105	274	9.899078	162	9.886026	436	10.113974	10.100922	10.214895	26
35	9.785269	273	9.898981	162	9.886288	436	10.113712	10.101019	10.214731	25
36	9.785433	273	9.898884	162	9.886549	436	10.113451	10.101116	10.214567	24
37	9.785597	273	9.898787	162	9.886810	435	10.113190	10.101213	10.214403	23
38	9.785761	273	9.898689	162	9.887072	435	10.112928	10.101311	10.214239	22
39	9.785925	273	9.898592	162	9.887333	435	10.112667	10.101408	10.214075	21
40	9.786089	273	9.898494	163	9.887594	435	10.112406	10.101506	10.213911	20
41	9.786252	272	9.898397	163	9.887855	435	10.112145	10.101603	10.213748	19
42	9.786416	272	9.898299	163	9.888116	435	10.111884	10.101701	10.213584	18
43	9.786579	272	9.898202	163	9.888377	435	10.111623	10.101798	10.213421	17
44	9.786742	272	9.898104	163	9.888639	435	10.111361	10.101896	10.213258	16
45	9.786906	272	9.898006	163	9.888900	435	10.111100	10.101994	10.213094	15
46	9.787069	272	9.897908	163	9.889160	435	10.110840	10.102092	10.212931	14
47	9.787232	271	9.897810	163	9.889421	435	10.110579	10.102190	10.212768	13
48	9.787395	271	9.897712	163	9.889682	435	10.110318	10.102288	10.212605	12
49	9.787557	271	9.897614	163	9.889943	435	10.110057	10.102386	10.212443	11
50	9.787720	271	9.897516	163	9.890204	435	10.109796	10.102484	10.212280	10
51	9.787883	271	9.897418	164	9.890465	435	10.109535	10.102582	10.212117	9
52	9.788045	271	9.897320	164	9.890725	434	10.109275	10.102680	10.211955	8
53	9.788208	271	9.897222	164	9.890986	434	10.109014	10.102778	10.211792	7
54	9.788370	270	9.897123	164	9.891247	434	10.108753	10.102877	10.211630	6
55	9.788532	270	9.897025	164	9.891507	434	10.108493	10.102975	10.211468	5
56	9.788694	270	9.896926	164	9.891768	434	10.108232	10.103074	10.211306	4
57	9.788856	270	9.896828	164	9.892028	434	10.107972	10.103172	10.211144	3
58	9.789018	270	9.896729	164	9.892289	434	10.107711	10.103271	10.210982	2
59	9.789180	270	9.896631	164	9.892549	434	10.107451	10.103369	10.210820	1
60	9.789342		9.896532		9.892810		10.107190	10.103468	10.210658	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

52 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

38 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.789342	269	9.896532	164	9.892810	434	10.107190	10.103468	10.210658	60
1	9.789504	269	9.896433	165	9.893070	434	10.106930	10.103567	10.210496	59
2	9.789665	269	9.896335	165	9.893331	434	10.106669	10.103665	10.210335	58
3	9.789827	269	9.896236	165	9.893591	434	10.106409	10.103764	10.210173	57
4	9.789988	269	9.896137	165	9.893851	434	10.106149	10.103863	10.210012	56
5	9.790149	269	9.896038	165	9.894111	434	10.105889	10.103962	10.209851	55
6	9.790310	268	9.895939	165	9.894371	434	10.105629	10.104061	10.209690	54
7	9.790471	268	9.895840	165	9.894632	434	10.105368	10.104160	10.209529	53
8	9.790632	268	9.895741	165	9.894892	433	10.105108	10.104259	10.209368	52
9	9.790793	268	9.895641	165	9.895152	433	10.104848	10.104359	10.209207	51
10	9.790954	268	9.895542	165	9.895412	433	10.104588	10.104458	10.209046	50
11	9.791115	268	9.895443	166	9.895672	433	10.104328	10.104557	10.208885	49
12	9.791275	267	9.895343	166	9.895932	433	10.104068	10.104657	10.208725	48
13	9.791436	267	9.895244	166	9.896192	433	10.103808	10.104756	10.208564	47
14	9.791596	267	9.895145	166	9.896452	433	10.103548	10.104855	10.208404	46
15	9.791757	267	9.895045	166	9.896712	433	10.103288	10.104955	10.208243	45
16	9.791917	267	9.894945	166	9.896971	433	10.103029	10.105055	10.208083	44
17	9.792077	267	9.894846	166	9.897231	433	10.102769	10.105154	10.207923	43
18	9.792237	266	9.894746	166	9.897491	433	10.102509	10.105254	10.207763	42
19	9.792397	266	9.894646	166	9.897751	433	10.102249	10.105354	10.207603	41
20	9.792557	266	9.894546	166	9.898010	433	10.101990	10.105454	10.207443	40
21	9.792716	266	9.894446	167	9.898270	433	10.101730	10.105554	10.207284	39
22	9.792876	266	9.894346	167	9.898530	433	10.101470	10.105654	10.207124	38
23	9.793035	266	9.894246	167	9.898789	433	10.101211	10.105754	10.206965	37
24	9.793195	265	9.894146	167	9.899049	432	10.100951	10.105854	10.206805	36
25	9.793354	265	9.894046	167	9.899308	432	10.100692	10.105954	10.206646	35
26	9.793514	265	9.893946	167	9.899568	432	10.100432	10.106054	10.206486	34
27	9.793673	265	9.893846	167	9.899827	432	10.100173	10.106154	10.206327	33
28	9.793832	265	9.893745	167	9.900086	432	10.099914	10.106255	10.206168	32
29	9.793991	265	9.893645	167	9.900346	432	10.099654	10.106355	10.206009	31
30	9.794150	264	9.893544	167	9.900605	432	10.099395	10.106456	10.205850	30
31	9.794308	264	9.893444	168	9.900864	432	10.099136	10.106556	10.205692	29
32	9.794467	264	9.893343	168	9.901124	432	10.098876	10.106657	10.205533	28
33	9.794626	264	9.893243	168	9.901383	432	10.098617	10.106757	10.205374	27
34	9.794784	264	9.893142	168	9.901642	432	10.098358	10.106858	10.205216	26
35	9.794942	264	9.893041	168	9.901901	432	10.098099	10.106959	10.205058	25
36	9.795101	264	9.892940	168	9.902160	432	10.097840	10.107060	10.204899	24
37	9.795259	263	9.892839	168	9.902419	432	10.097581	10.107161	10.204741	23
38	9.795417	263	9.892739	168	9.902679	432	10.097321	10.107261	10.204583	22
39	9.795575	263	9.892638	168	9.902938	432	10.097062	10.107362	10.204425	21
40	9.795733	263	9.892536	168	9.903197	432	10.096803	10.107464	10.204267	20
41	9.795891	263	9.892435	169	9.903455	431	10.096545	10.107565	10.204109	19
42	9.796049	263	9.892334	169	9.903714	431	10.096286	10.107666	10.203951	18
43	9.796206	263	9.892233	169	9.903973	431	10.096027	10.107767	10.203794	17
44	9.796364	262	9.892132	169	9.904232	431	10.095768	10.107868	10.203636	16
45	9.796521	262	9.892030	169	9.904491	431	10.095509	10.107970	10.203479	15
46	9.796679	262	9.891929	169	9.904750	431	10.095250	10.108071	10.203321	14
47	9.796836	262	9.891827	169	9.905008	431	10.094992	10.108173	10.203164	13
48	9.796993	262	9.891726	169	9.905267	431	10.094733	10.108274	10.203007	12
49	9.797150	262	9.891624	169	9.905526	431	10.094474	10.108376	10.202850	11
50	9.797307	261	9.891523	169	9.905784	431	10.094216	10.108477	10.202693	10
51	9.797464	261	9.891421	170	9.906043	431	10.093957	10.108579	10.202536	9
52	9.797621	261	9.891319	170	9.906302	431	10.093698	10.108681	10.202379	8
53	9.797.77	261	9.891217	170	9.906560	431	10.093440	10.108783	10.202223	7
54	9.797934	261	9.891115	170	9.906819	431	10.093181	10.108885	10.202066	6
55	9.798091	261	9.891013	170	9.907077	431	10.092923	10.108987	10.201909	5
56	9.798247	261	9.890911	170	9.907336	431	10.092664	10.109089	10.201753	4
57	9.798403	260	9.890809	170	9.907594	431	10.092406	10.109191	10.201597	3
58	9.798560	260	9.890707	170	9.907852	431	10.092148	10.109293	10.201440	2
59	9.798716	260	9.890605	170	9.908111	431	10.091889	10.109395	10.201284	1
60	9.798872		9.890503		9.908369		10.091631	10.109497	10.201128	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

51 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

39 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.798872	260	9.890503	170	9.908369	430	10.091631	10.109497	10.201128	60
1	9.799028	260	9.890400	171	9.908628	430	10.091372	10.109600	10.200972	59
2	9.799184	260	9.890298	171	9.908886	430	10.091114	10.109702	10.200816	58
3	9.799339	259	9.890195	171	9.909144	430	10.090856	10.109805	10.200661	57
4	9.799495	259	9.890093	171	9.909402	430	10.090598	10.109907	10.200505	56
5	9.799651	259	9.889990	171	9.909660	430	10.090340	10.110010	10.200349	55
6	9.799806	259	9.889888	171	9.909918	430	10.090082	10.110112	10.200194	54
7	9.799962	259	9.889785	171	9.910177	430	10.089823	10.110215	10.200038	53
8	9.800117	259	9.889682	171	9.910435	430	10.089565	10.110318	10.199883	52
9	9.800272	258	9.889579	171	9.910693	430	10.089307	10.110421	10.199728	51
10	9.800427	258	9.889477	171	9.910951	430	10.089049	10.110523	10.199573	50
11	9.800582	258	9.889374	172	9.911209	430	10.088791	10.110626	10.199418	49
12	9.800737	258	9.889271	172	9.911467	430	10.088533	10.110729	10.199263	48
13	9.800892	258	9.889168	172	9.911724	430	10.088276	10.110832	10.199108	47
14	9.801047	258	9.889064	172	9.911982	430	10.088018	10.110936	10.198953	46
15	9.801201	258	9.888961	172	9.912240	430	10.087760	10.111039	10.198799	45
16	9.801356	257	9.888858	172	9.912498	430	10.087502	10.111142	10.198644	44
17	9.801511	257	9.888755	172	9.912756	430	10.087244	10.111245	10.198489	43
18	9.801665	257	9.888651	172	9.913014	430	10.086986	10.111349	10.198335	42
19	9.801819	257	9.888548	172	9.913271	429	10.086729	10.111452	10.198181	41
20	9.801973	257	9.888444	173	9.913529	429	10.086471	10.111556	10.198027	40
21	9.802128	257	9.888341	173	9.913787	429	10.086213	10.111659	10.197872	39
22	9.802282	256	9.888237	173	9.914044	429	10.085956	10.111763	10.197718	38
23	9.802436	256	9.888134	173	9.914302	429	10.085698	10.111866	10.197564	37
24	9.802589	256	9.888030	173	9.914560	429	10.085440	10.111970	10.197411	36
25	9.802743	256	9.887926	173	9.914817	429	10.085183	10.112074	10.197257	35
26	9.802897	256	9.887822	173	9.915075	429	10.084925	10.112178	10.197103	34
27	9.803050	256	9.887718	173	9.915332	429	10.084668	10.112282	10.196950	33
28	9.803204	256	9.887614	173	9.915590	429	10.084410	10.112386	10.196796	32
29	9.803357	255	9.887510	173	9.915847	429	10.084153	10.112490	10.196643	31
30	9.803511	255	9.887406	174	9.916104	429	10.083896	10.112594	10.196489	30
31	9.803664	255	9.887302	174	9.916362	429	10.083638	10.112698	10.196336	29
32	9.803817	255	9.887198	174	9.916619	429	10.083381	10.112802	10.196183	28
33	9.803970	255	9.887093	174	9.916877	429	10.083123	10.112907	10.196030	27
34	9.804123	255	9.886989	174	9.917134	429	10.082866	10.113011	10.195877	26
35	9.804276	254	9.886885	174	9.917391	429	10.082609	10.113115	10.195724	25
36	9.804428	254	9.886780	174	9.917648	429	10.082352	10.113220	10.195572	24
37	9.804581	254	9.886676	174	9.917905	429	10.082095	10.113324	10.195419	23
38	9.804734	254	9.886571	174	9.918163	429	10.081837	10.113429	10.195266	22
39	9.804886	254	9.886466	174	9.918420	429	10.081580	10.113534	10.195114	21
40	9.805039	254	9.886362	175	9.918677	429	10.081323	10.113638	10.194961	20
41	9.805191	254	9.886257	175	9.918934	428	10.081066	10.113743	10.194809	19
42	9.805343	253	9.886152	175	9.919191	428	10.080809	10.113848	10.194657	18
43	9.805495	253	9.886047	175	9.919448	428	10.080552	10.113953	10.194505	17
44	9.805647	253	9.885942	175	9.919705	428	10.080295	10.114058	10.194353	16
45	9.805799	253	9.885837	175	9.919962	428	10.080038	10.114163	10.194201	15
46	9.805951	253	9.885732	175	9.920219	428	10.079781	10.114268	10.194049	14
47	9.806103	253	9.885627	175	9.920476	428	10.079524	10.114373	10.193897	13
48	9.806254	253	9.885522	175	9.920733	428	10.079267	10.114478	10.193746	12
49	9.806406	252	9.885416	175	9.920990	428	10.079010	10.114584	10.193594	11
50	9.806557	252	9.885311	176	9.921247	428	10.078753	10.114689	10.193443	10
51	9.806709	252	9.885205	176	9.921503	428	10.078497	10.114795	10.193291	9
52	9.806860	252	9.885100	176	9.921760	428	10.078240	10.114900	10.193140	8
53	9.807011	252	9.884994	176	9.922017	428	10.077983	10.115006	10.192989	7
54	9.807163	252	9.884889	176	9.922274	428	10.077726	10.115111	10.192837	6
55	9.807314	252	9.884783	176	9.922530	428	10.077470	10.115217	10.192686	5
56	9.807465	251	9.884677	176	9.922787	428	10.077213	10.115323	10.192535	4
57	9.807615	251	9.884572	176	9.923044	428	10.076956	10.115428	10.192385	3
58	9.807766	251	9.884466	176	9.923300	428	10.076700	10.115534	10.192234	2
59	9.807917	251	9.884360	176	9.923557	428	10.076443	10.115640	10.192083	1
60	9.808067		9.884254		9.923813		10.076187	10.115746	10.191933	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

50 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

40 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.808067	251	9.884254	177	9.923813	428	10.076187	10.115746	10.191933	60
1	9.808218	251	9.884148	177	9.924070	428	10.075930	10.115852	10.191782	59
2	9.808368	251	9.884042	177	9.924327	428	10.075673	10.115958	10.191632	58
3	9.808519	250	9.883936	177	9.924583	427	10.075417	10.116064	10.191481	57
4	9.808669	250	9.883829	177	9.924840	427	10.075160	10.116171	10.191331	56
5	9.808819	250	9.883723	177	9.925096	427	10.074904	10.116277	10.191181	55
6	9.808969	250	9.883617	177	9.925352	427	10.074648	10.116383	10.191031	54
7	9.809119	250	9.883510	177	9.925609	427	10.074391	10.116490	10.190881	53
8	9.809269	250	9.883404	177	9.925865	427	10.074135	10.116596	10.190731	52
9	9.809419	249	9.883297	178	9.926122	427	10.073878	10.116703	10.190581	51
10	9.809569	249	9.883191	178	9.926378	427	10.073622	10.116809	10.190431	50
11	9.809718	249	9.883084	178	9.926634	427	10.073366	10.116916	10.190282	49
12	9.809868	249	9.882977	178	9.926890	427	10.073110	10.117023	10.190132	48
13	9.810017	249	9.882871	178	9.927147	427	10.072853	10.117129	10.189983	47
14	9.810167	249	9.882764	178	9.927403	427	10.072597	10.117236	10.189833	46
15	9.810316	248	9.882657	178	9.927659	427	10.072341	10.117343	10.189684	45
16	9.810465	248	9.882550	178	9.927915	427	10.072085	10.117450	10.189535	44
17	9.810614	248	9.882443	178	9.928171	427	10.071829	10.117557	10.189386	43
18	9.810763	248	9.882336	179	9.928427	427	10.071573	10.117664	10.189237	42
19	9.810912	248	9.882229	179	9.928683	427	10.071317	10.117771	10.189088	41
20	9.811061	248	9.882121	179	9.928940	427	10.071060	10.117879	10.188939	40
21	9.811210	248	9.882014	179	9.929196	427	10.070804	10.117986	10.188790	39
22	9.811358	247	9.881907	179	9.929452	427	10.070548	10.118093	10.188642	38
23	9.811507	247	9.881799	179	9.929708	427	10.070292	10.118201	10.188493	37
24	9.811655	247	9.881692	179	9.929964	427	10.070036	10.118308	10.188345	36
25	9.811804	247	9.881584	179	9.930220	427	10.069780	10.118416	10.188196	35
26	9.811952	247	9.881477	179	9.930475	427	10.069525	10.118523	10.188048	34
27	9.812100	247	9.881369	179	9.930731	426	10.069269	10.118631	10.187900	33
28	9.812248	247	9.881261	180	9.930987	426	10.069013	10.118739	10.187752	32
29	9.812396	246	9.881153	180	9.931243	426	10.068757	10.118847	10.187604	31
30	9.812544	246	9.881046	180	9.931499	426	10.068501	10.118954	10.187456	30
31	9.812692	246	9.880938	180	9.931755	426	10.068245	10.119062	10.187308	29
32	9.812840	246	9.880830	180	9.932010	426	10.067990	10.119170	10.187160	28
33	9.812988	246	9.880722	180	9.932266	426	10.067734	10.119278	10.187012	27
34	9.813135	246	9.880613	180	9.932522	426	10.067478	10.119387	10.186865	26
35	9.813283	246	9.880505	180	9.932778	426	10.067222	10.119495	10.186717	25
36	9.813430	245	9.880397	180	9.933033	426	10.066967	10.119603	10.186570	24
37	9.813578	245	9.880289	181	9.933289	426	10.066711	10.119711	10.186422	23
38	9.813725	245	9.880180	181	9.933545	426	10.066455	10.119820	10.186275	22
39	9.813872	245	9.880072	181	9.933800	426	10.066200	10.119928	10.186128	21
40	9.814019	245	9.879963	181	9.934056	426	10.065944	10.120037	10.185981	20
41	9.814166	245	9.879855	181	9.934311	426	10.065689	10.120145	10.185834	19
42	9.814313	245	9.879746	181	9.934567	426	10.065433	10.120254	10.185687	18
43	9.814460	244	9.879637	181	9.934823	426	10.065177	10.120363	10.185540	17
44	9.814607	244	9.879529	181	9.935078	426	10.064922	10.120471	10.185393	16
45	9.814753	244	9.879420	181	9.935333	426	10.064667	10.120580	10.185247	15
46	9.814900	244	9.879311	181	9.935589	426	10.064411	10.120689	10.185100	14
47	9.815046	244	9.879202	182	9.935844	426	10.064156	10.120798	10.184954	13
48	9.815193	244	9.879093	182	9.936100	426	10.063900	10.120907	10.184807	12
49	9.815339	244	9.878984	182	9.936355	426	10.063645	10.121016	10.184661	11
50	9.815485	243	9.878875	182	9.936610	426	10.063390	10.121125	10.184515	10
51	9.815632	243	9.878766	182	9.936866	426	10.063134	10.121234	10.184368	9
52	9.815778	243	9.878656	182	9.937121	426	10.062879	10.121344	10.184222	8
53	9.815924	243	9.878547	182	9.937376	425	10.062624	10.121453	10.184076	7
54	9.816069	243	9.878438	182	9.937632	425	10.062368	10.121562	10.183931	6
55	9.816215	243	9.878328	182	9.937887	425	10.062113	10.121672	10.183785	5
56	9.816361	243	9.878219	183	9.938142	425	10.061858	10.121781	10.183639	4
57	9.816507	242	9.878109	183	9.938398	425	10.061602	10.121891	10.183493	3
58	9.816652	242	9.877999	183	9.938653	425	10.061347	10.122001	10.183348	2
59	9.816798	242	9.877890	183	9.938908	425	10.061092	10.122110	10.183202	1
60	9.816943		9.877780		9.939163		10.060837	10.122220	10.183057	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

49 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

41 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.816943	242	9.877780	183	9.939163	425	10.060837	10.122220	10.183057	60
1	9.817088	242	9.877670	183	9.939418	425	10.060582	10.122330	10.182912	59
2	9.817233	242	9.877560	183	9.939673	425	10.060327	10.122440	10.182767	58
3	9.817379	242	9.877450	183	9.939928	425	10.060072	10.122550	10.182621	57
4	9.817524	241	9.877340	183	9.940183	425	10.059817	10.122660	10.182476	56
5	9.817668	241	9.877230	184	9.940438	425	10.059562	10.122770	10.182332	55
6	9.817813	241	9.877120	184	9.940694	425	10.059306	10.122880	10.182187	54
7	9.817958	241	9.877010	184	9.940949	425	10.059051	10.122990	10.182042	53
8	9.818103	241	9.876899	184	9.941204	425	10.058796	10.123101	10.181897	52
9	9.818247	241	9.876789	184	9.941458	425	10.058542	10.123211	10.181753	51
10	9.818392	241	9.876678	184	9.941714	425	10.058286	10.123322	10.181608	50
11	9.818536	240	9.876568	184	9.941968	425	10.058032	10.123432	10.181464	49
12	9.818681	210	9.876457	184	9.942223	425	10.057777	10.123543	10.181319	48
13	9.818825	240	9.876347	184	9.942478	425	10.057522	10.123653	10.181175	47
14	9.818969	240	9.876236	185	9.942733	425	10.057267	10.123764	10.181031	46
15	9.819113	240	9.876125	185	9.942988	425	10.057012	10.123875	10.180887	45
16	9.819257	240	9.876014	185	9.943243	425	10.056757	10.123986	10.180743	44
17	9.819401	240	9.875904	185	9.943498	425	10.056502	10.124096	10.180599	43
18	9.819545	239	9.875793	185	9.943752	425	10.056248	10.124207	10.180455	42
19	9.819689	239	9.875682	185	9.944007	425	10.055993	10.124318	10.180311	41
20	9.819832	239	9.875571	185	9.944262	425	10.055738	10.124429	10.180168	40
21	9.819976	239	9.875459	185	9.944517	425	10.055483	10.124541	10.180024	39
22	9.820120	239	9.875348	185	9.944771	425	10.055229	10.124652	10.179880	38
23	9.820263	239	9.875237	185	9.945026	425	10.054974	10.124763	10.179737	37
24	9.820406	239	9.875126	186	9.945281	425	10.054719	10.124874	10.179594	36
25	9.820550	238	9.875014	186	9.945535	425	10.054465	10.124986	10.179450	35
26	9.820693	238	9.874903	186	9.945790	425	10.054210	10.125097	10.179307	34
27	9.820836	238	9.874791	186	9.946045	425	10.053955	10.125209	10.179164	33
28	9.820979	238	9.874680	186	9.946299	425	10.053701	10.125320	10.179021	32
29	9.821122	238	9.874568	186	9.946554	425	10.053446	10.125432	10.178878	31
30	9.821265	238	9.874456	186	9.946808	425	10.053192	10.125544	10.178735	30
31	9.821407	238	9.874344	186	9.947063	424	10.052937	10.125656	10.178593	29
32	9.821550	238	9.874232	186	9.947318	424	10.052682	10.125768	10.178450	28
33	9.821693	237	9.874121	187	9.947572	424	10.052428	10.125879	10.178307	27
34	9.821835	237	9.874009	187	9.947826	424	10.052174	10.125991	10.178165	26
35	9.821977	237	9.873896	187	9.948081	424	10.051919	10.126104	10.178023	25
36	9.822120	237	9.873784	187	9.948336	424	10.051664	10.126216	10.177880	24
37	9.822262	237	9.873672	187	9.948590	424	10.051410	10.126328	10.177738	23
38	9.822404	237	9.873560	187	9.948844	424	10.051156	10.126440	10.177596	22
39	9.822546	237	9.873448	187	9.949099	424	10.050901	10.126552	10.177454	21
40	9.822688	236	9.873335	187	9.949353	424	10.050647	10.126665	10.177312	20
41	9.822830	236	9.873223	187	9.949607	424	10.050393	10.126777	10.177170	19
42	9.822972	236	9.873110	188	9.949862	424	10.050138	10.126890	10.177028	18
43	9.823114	236	9.872998	188	9.950116	424	10.049884	10.127002	10.176886	17
44	9.823255	236	9.872885	188	9.950370	424	10.049630	10.127115	10.176745	16
45	9.823397	236	9.872772	188	9.950625	424	10.049375	10.127228	10.176603	15
46	9.823539	236	9.872659	188	9.950879	424	10.049121	10.127341	10.176461	14
47	9.823680	235	9.872547	188	9.951133	424	10.048867	10.127453	10.176320	13
48	9.823821	235	9.872434	188	9.951388	424	10.048612	10.127566	10.176179	12
49	9.823963	235	9.872321	188	9.951642	424	10.048358	10.127679	10.176037	11
50	9.824104	235	9.872208	188	9.951896	424	10.048104	10.127792	10.175896	10
51	9.824245	235	9.872095	189	9.952150	424	10.047850	10.127905	10.175755	9
52	9.824386	235	9.871981	189	9.952405	424	10.047595	10.128019	10.175614	8
53	9.824527	235	9.871868	189	9.952659	424	10.047341	10.128132	10.175473	7
54	9.824668	234	9.871755	189	9.952913	424	10.047087	10.128245	10.175332	6
55	9.824808	234	9.871641	189	9.953167	423	10.046833	10.128359	10.175192	5
56	9.824949	234	9.871528	189	9.953421	423	10.046579	10.128472	10.175051	4
57	9.825090	234	9.871414	189	9.953675	423	10.046325	10.128586	10.174910	3
58	9.825230	234	9.871301	189	9.953929	423	10.046071	10.128699	10.174770	2
59	9.825371	234	9.871187	189	9.954183	423	10.045817	10.128813	10.174629	1
60	9.825511		9.871073		9.954437		10.045563	10.128927	10.174489	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

48 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

42 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.825511	234	9.871073	190	9.954437	423	10.045563	10.128927	10.174489	60
1	9.825651	233	9.870960	190	9.954691	423	10.045309	10.129040	10.174349	59
2	9.825791	233	9.870846	190	9.954945	423	10.045055	10.129154	10.174209	58
3	9.825931	233	9.870732	190	9.955200	423	10.044800	10.129268	10.174069	57
4	9.826071	233	9.870618	190	9.955454	423	10.044546	10.129382	10.173929	56
5	9.826211	233	9.870504	190	9.955707	423	10.044293	10.129496	10.173789	55
6	9.826351	233	9.870390	190	9.955961	423	10.044039	10.129610	10.173649	54
7	9.826491	233	9.870276	190	9.956215	423	10.043785	10.129724	10.173509	53
8	9.826631	233	9.870161	190	9.956469	423	10.043531	10.129839	10.173369	52
9	9.826770	232	9.870047	191	9.956723	423	10.043277	10.129953	10.173230	51
10	9.826910	232	9.869933	191	9.956977	423	10.043023	10.130067	10.173090	50
11	9.827049	232	9.869818	191	9.957231	423	10.042769	10.130182	10.172951	49
12	9.827189	232	9.869704	191	9.957485	423	10.042515	10.130296	10.172811	48
13	9.827328	232	9.869589	191	9.957739	423	10.042261	10.130411	10.172672	47
14	9.827467	232	9.869474	191	9.957993	423	10.042007	10.130526	10.172533	46
15	9.827606	232	9.869360	191	9.958246	423	10.041754	10.130640	10.172394	45
16	9.827745	232	9.869245	191	9.958500	423	10.041500	10.130755	10.172255	44
17	9.827884	231	9.869130	191	9.958754	423	10.041246	10.130870	10.172116	43
18	9.828023	231	9.869015	192	9.959008	423	10.040992	10.130985	10.171977	42
19	9.828162	231	9.868900	192	9.959262	423	10.040738	10.131100	10.171838	41
20	9.828301	231	9.868785	192	9.959516	423	10.040484	10.131215	10.171699	40
21	9.828439	231	9.868670	192	9.959769	423	10.040231	10.131330	10.171561	39
22	9.828578	231	9.868555	192	9.960023	423	10.039977	10.131445	10.171422	38
23	9.828716	231	9.868440	192	9.960277	423	10.039723	10.131560	10.171284	37
24	9.828855	230	9.868324	192	9.960531	423	10.039469	10.131676	10.171145	36
25	9.828993	230	9.868209	192	9.960784	423	10.039216	10.131791	10.171007	35
26	9.829131	230	9.868093	192	9.961038	423	10.038962	10.131907	10.170869	34
27	9.829269	230	9.867978	193	9.961291	423	10.038709	10.132022	10.170731	33
28	9.829407	230	9.867862	193	9.961545	423	10.038455	10.132138	10.170593	32
29	9.829545	230	9.867747	193	9.961799	423	10.038201	10.132253	10.170455	31
30	9.829683	230	9.867631	193	9.962052	423	10.037948	10.132369	10.170317	30
31	9.829821	229	9.867515	193	9.962306	423	10.037694	10.132485	10.170179	29
32	9.829959	229	9.867399	193	9.962560	423	10.037440	10.132601	10.170041	28
33	9.830097	229	9.867283	193	9.962813	423	10.037187	10.132717	10.169903	27
34	9.830234	229	9.867167	193	9.963067	423	10.036933	10.132833	10.169766	26
35	9.830372	229	9.867051	193	9.963320	423	10.036680	10.132949	10.169628	25
36	9.830509	229	9.866935	194	9.963574	423	10.036426	10.133065	10.169491	24
37	9.830646	229	9.866819	194	9.963827	423	10.036173	10.133181	10.169354	23
38	9.830784	229	9.866703	194	9.964081	423	10.035919	10.133297	10.169216	22
39	9.830921	228	9.866586	194	9.964335	423	10.035665	10.133414	10.169079	21
40	9.831058	228	9.866470	194	9.964588	423	10.035412	10.133530	10.168942	20
41	9.831195	228	9.866353	194	9.964842	422	10.035158	10.133647	10.168805	19
42	9.831332	228	9.866237	194	9.965095	422	10.034905	10.133763	10.168668	18
43	9.831469	228	9.866120	194	9.965349	422	10.034651	10.133880	10.168531	17
44	9.831606	228	9.866004	195	9.965602	422	10.034398	10.133996	10.168394	16
45	9.831742	228	9.865887	195	9.965855	422	10.034145	10.134113	10.168258	15
46	9.831879	228	9.865770	195	9.966109	422	10.033891	10.134230	10.168121	14
47	9.832015	227	9.865653	195	9.966362	422	10.033638	10.134347	10.167985	13
48	9.832152	227	9.865536	195	9.966616	422	10.033384	10.134464	10.167848	12
49	9.832288	227	9.865419	195	9.966869	422	10.033131	10.134581	10.167712	11
50	9.832425	227	9.865302	195	9.967123	422	10.032877	10.134698	10.167575	10
51	9.832561	227	9.865185	195	9.967376	422	10.032624	10.134815	10.167439	9
52	9.832697	227	9.865068	195	9.967629	422	10.032371	10.134932	10.167303	8
53	9.832833	227	9.864950	195	9.967883	422	10.032117	10.135050	10.167167	7
54	9.832969	226	9.864833	196	9.968136	422	10.031864	10.135167	10.167031	6
55	9.833105	226	9.864716	196	9.968389	422	10.031611	10.135284	10.166895	5
56	9.833241	226	9.864598	196	9.968643	422	10.031357	10.135402	10.166759	4
57	9.833377	226	9.864481	196	9.968896	422	10.031104	10.135519	10.166623	3
58	9.833512	226	9.864363	196	9.969149	422	10.030851	10.135637	10.166488	2
59	9.833648	226	9.864245	196	9.969403	422	10.030597	10.135755	10.166352	1
60	9.833783		9.864127		9.969656		10.030344	10.135873	10.166217	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

47 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

43 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.833783	226	9.864127	196	9.969656	422	10.030344	10.135873	10.166217	60
1	9.833919	225	9.864010	196	9.969909	422	10.030091	10.135990	10.166081	59
2	9.834054	225	9.863892	197	9.970162	422	10.029838	10.136108	10.165946	58
3	9.834189	225	9.863774	197	9.970416	422	10.029584	10.136226	10.165811	57
4	9.834325	225	9.863656	197	9.970669	422	10.029331	10.136344	10.165675	56
5	9.834460	225	9.863538	197	9.970922	422	10.029078	10.136462	10.165540	55
6	9.834595	225	9.863419	197	9.971175	422	10.028825	10.136581	10.165405	54
7	9.834730	225	9.863301	197	9.971429	422	10.028571	10.136699	10.165270	53
8	9.834865	225	9.863183	197	9.971682	422	10.028318	10.136817	10.165135	52
9	9.834999	224	9.863064	197	9.971935	422	10.028065	10.136936	10.165001	51
10	9.835134	224	9.862946	198	9.972188	422	10.027812	10.137054	10.164866	50
11	9.835269	224	9.862827	198	9.972441	422	10.027559	10.137173	10.164731	49
12	9.835403	224	9.862709	198	9.972694	422	10.027306	10.137291	10.164597	48
13	9.835538	224	9.862590	198	9.972948	422	10.027052	10.137410	10.164462	47
14	9.835672	224	9.862471	198	9.973201	422	10.026799	10.137529	10.164328	46
15	9.835807	224	9.862353	198	9.973454	422	10.026546	10.137647	10.164193	45
16	9.835941	224	9.862234	198	9 973707	422	10.026293	10.137766	10.164059	44
17	9.836075	223	9.862115	198	9.973960	422	10.026040	10.137885	10.163925	43
18	9.836200	223	9.861996	198	9.974213	422	10.025787	10.138004	10.163791	42
19	9.836343	223	9.861877	198	9.974466	422	10.025534	10.138123	10.163657	41
20	9.836477	223	9.861758	199	9.974719	422	10.025281	10.138242	10.163523	40
21	9.836611	223	9.861638	199	9.974973	422	10.025027	10.138362	10.163389	39
22	9.836745	223	9.861519	199	9.975226	422	10.024774	10.138481	10.163255	38
23	9.836878	223	9.861400	199	9.975479	422	10.024521	10.138600	10.163122	37
24	9.837012	222	9.861280	199	9.975732	422	10.024268	10.138720	10.162988	36
25	9.837146	222	9.861161	199	9.975985	422	10.024015	10.138839	10.162854	35
26	9.837279	222	9.861041	199	9.976238	422	10.023762	10.138959	10.162721	34
27	9.837412	222	9.860922	199	9.976491	422	10.023509	10.139078	10.162588	33
28	9.837546	222	9.860802	199	9.976744	422	10.023256	10.139198	10.162454	32
29	9.837679	222	9.860682	200	9.976997	422	10.023003	10.139318	10.162321	31
30	9.837812	222	9.860562	200	9.977250	422	10.022750	10.139438	10.162188	30
31	9.837945	222	9.860442	200	9.977503	422	10.022497	10.139558	10.162055	29
32	9.838078	221	9.860322	200	9:977756	422	10.022244	10.139678	10.161922	28
33	9.838211	221	9.860202	200	9.978009	422	10.021991	10.139798	10.161789	27
34	9.838344	221	9.860082	200	9.978262	422	10.021738	10.139918	10.161656	26
35	9.838477	221	9.859962	200	9.978515	422	10.021485	10.140038	10.161523	25
36	9.838610	221	9.859842	200	9.978768	422	10.021232	10.140158	10.161390	24
37	9.838742	221	9.859721	201	9.979021	422	10.020979	10.140279	10.161258	23
38	9.838875	221	9.859601	201	9.979274	422	10.020726	10.140399	10.161125	22
39	9.839007	221	9.859480	201	9.979527	422	10.020473	10.140520	10.160993	21
40	9.839140	220	9.859360	201	9.979780	422	10.020220	10.140640	10.160860	20
41	9.839272	220	9.859239	201	9.980033	422	10.019967	10.140761	10.160728	19
42	9.839404	220	9.859119	201	9.980286	422	10.019714	10.140881	10.160596	18
43	9.839536	220	9.858998	201	9.980538	422	10.019462	10.141002	10.160464	17
44	9.839668	220	9.858877	201	9.980791	422	10.019209	10.141123	10.160332	16
45	9.839800	220	9.858756	202	9.981044	422	10.018956	10.141244	10.160200	15
46	9.839932	220	9.858635	202	9.981297	422	10.018703	10.141365	10.160068	14
47	9.840064	219	9.858514	202	9.981550	422	10.018450	10.141486	10.159936	13
48	9.840196	219	9.858393	202	9.981803	422	10.018197	10.141607	10.159804	12
49	9.840328	219	9.858272	202	9.982056	422	10.017944	10.141728	10.159672	11
50	9.840459	219	9.858151	202	9.982309	421	10.017691	10.141849	10.159541	10
51	9.840591	219	9.858029	202	9.982562	421	10.017438	10.141971	10.159409	9
52	9.840722	219	9.857908	202	9.982814	421	10.017186	10.142092	10.159278	8
53	9.840854	219	9.857786	202	9.983067	421	10.016933	10.142214	10.159146	7
54	9.840985	219	9.857665	203	9.983320	421	10.016680	10.142335	10.159015	6
55	9.841116	218	9.857543	203	9.983573	421	10.016427	10.142457	10.158884	5
56	9.841247	218	9.857422	203	9.983826	421	10.016174	10.142578	10.158753	4
57	9.841378	218	9.857300	203	9.984079	421	10.015921	10.142700	10.158622	3
58	9.841509	218	9.857178	203	9.984331	421	10.015669	10.142822	10.158491	2
59	9.841640	218	9.857056	203	9.984584	421	10.015416	10.142944	10.158360	1
60	9.841771		9.856934		9.984837		10.015163	10.143066	10.158229	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

46 Degrees.

TABLE XXV.

LOGARITHMIC SINES, TANGENTS, AND SECANTS.

44 Degrees.

M	Sine.	Diff.	Co-sine.	D.	Tang.	Diff.	Co-tan.	Secant.	Co-sec.	M
0	9.841771	218	9.856934	203	9.984837	421	10.015163	10.143066	10.158229	60
1	9.841902	218	9.856812	203	9.985090	421	10.014910	10.143188	10.158098	59
2	9.842033	218	9.856690	204	9.985343	421	10.014657	10.143310	10.157967	58
3	9.842163	217	9.856568	204	9.985596	421	10.014404	10.143432	10.157837	57
4	9.842294	217	9.856446	204	9.985848	421	10.014152	10.143554	10.157706	56
5	9.842424	217	9.856323	204	9.986101	421	10.013899	10.143677	10.157576	55
6	9.842555	217	9.856201	204	9.986354	421	10.013646	10.143799	10.157445	54
7	9.842685	217	9.856078	204	9.986607	421	10.013393	10.143922	10.157315	53
8	9.842815	217	9.855956	204	9.986860	421	10.013140	10.144044	10.157185	52
9	9.842946	217	9.855833	204	9.987112	421	10.012888	10.144167	10.157054	51
10	9.843076	217	9.855711	205	9.987365	421	10.012635	10.144289	10.156924	50
11	9.843206	216	9.855588	205	9.987618	421	10.012382	10.144412	10.156794	49
12	9.843336	216	9.855465	205	9.987871	421	10.012129	10.144535	10.156664	48
13	9.843466	216	9.855342	205	9.988123	421	10.011877	10.144658	10.156534	47
14	9.843595	216	9.855219	205	9.988376	421	10.011624	10.144781	10.156405	46
15	9.843725	216	9.855096	205	9.988629	421	10.011371	10.144904	10.156275	45
16	9.843855	216	9.854973	205	9.988882	421	10.011118	10.145027	10.156145	44
17	9.843984	216	9.854850	205	9.989134	421	10.010866	10.145150	10.156016	43
18	9.844114	216	9.854727	206	9.989387	421	10.010613	10.145273	10.155886	42
19	9.844243	215	9.854603	206	9.989640	421	10.010360	10.145397	10.155757	41
20	9.844372	215	9.854480	206	9.989893	421	10.010107	10.145520	10.155628	40
21	9.844502	215	9.854356	206	9.990145	421	10.009855	10.145644	10.155498	39
22	9.844631	215	9.854233	206	9.990398	421	10.009602	10.145767	10.155369	38
23	9.844760	215	9.854109	206	9.990651	421	10.009349	10.145891	10.155240	37
24	9.844889	215	9.853986	206	9.990903	421	10.009097	10.146014	10.155111	36
25	9.845018	215	9.853862	206	9.991156	421	10.008844	10.146138	10.154982	35
26	9.845147	215	9.853738	206	9.991409	421	10.008591	10.146262	10.154853	34
27	9.845276	214	9.853614	207	9.991662	421	10.008338	10.146386	10.154724	33
28	9.845405	214	9.853490	207	9.991914	421	10.008086	10.146510	10.154595	32
29	9.845533	214	9.853366	207	9.992167	421	10.007833	10.146634	10.154467	31
30	9.845662	214	9.853242	207	9.992420	421	10.007580	10.146758	10.154338	30
31	9.845790	214	9.853118	207	9.992672	421	10.007328	10.146882	10.154210	29
32	9.845919	214	9.852994	207	9.992925	421	10.007075	10.147006	10.154081	28
33	9.846047	214	9.852869	207	9.993178	421	10.006822	10.147131	10.153953	27
34	9.846175	214	9.852745	207	9.993430	421	10.006570	10.147255	10.153825	26
35	9.846304	214	9.852620	207	9.993683	421	10.006317	10.147380	10.153696	25
36	9.846432	213	9.852496	208	9.993936	421	10.006064	10.147504	10.153568	24
37	9.846560	213	9.852371	208	9.994189	421	10.005811	10.147629	10.153440	23
38	9.846688	213	9.852247	208	9.994441	421	10.005559	10.147753	10.153312	22
39	9.846816	213	9.852122	208	9.994694	421	10.005306	10.147878	10.153184	21
40	9.846944	213	9.851997	208	9.994947	421	10.005053	10.148003	10.153056	20
41	9.847071	213	9.851872	208	9.995199	421	10.004801	10.148128	10.152929	19
42	9.847199	213	9.851747	208	9.995452	421	10.004548	10.148253	10.152801	18
43	9.847327	213	9.851622	208	9.995705	421	10.004295	10.148378	10.152673	17
44	9.847454	212	9.851497	209	9.995957	421	10.004043	10.148503	10.152546	16
45	9.847582	212	9.851372	209	9.996210	421	10.003790	10.148628	10.152418	15
46	9.847709	212	9.851246	209	9.996463	421	10.003537	10.148754	10.152291	14
47	9.847836	212	9.851121	209	9.996715	421	10.003285	10.148879	10.152164	13
48	9.847964	212	9.850996	209	9.996968	421	10.003032	10.149004	10.152036	12
49	9.848091	212	9.850870	209	9.997221	421	10.002779	10.149130	10.151909	11
50	9.848218	212	9.850745	209	9.997473	421	10.002527	10.149255	10.151782	10
51	9.848345	212	9.850619	209	9.997726	421	10.002274	10.149381	10.151655	9
52	9.848472	211	9.850493	210	9.997979	421	10.002021	10.149507	10.151528	8
53	9.848599	211	9.850368	210	9.998231	421	10.001769	10.149632	10.151401	7
54	9.848726	211	9.850242	210	9.998484	421	10.001516	10.149758	10.151274	6
55	9.848852	211	9.850116	210	9.998737	421	10.001263	10.149884	10.151148	5
56	9.848979	211	9.849990	210	9.998989	421	10.001011	10.150010	10.151021	4
57	9.849106	211	9.849864	210	9.999242	421	10.000758	10.150136	10.150894	3
58	9.849232	211	9.849738	210	9.999495	421	10.000505	10.150262	10.150768	2
59	9.849359	211	9.849611	210	9.999747	421	10.000253	10.150389	10.150641	1
60	9.849485		9.849485		0.000009		10.000000	10.150515	10.150515	0
M	Co-sine		Sine.		Co-tan.		Tang.	Co-sec.	Secant.	M

45 Degrees.

TABLE XXVI.——NATURAL SINES.

M	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	M
0	000000	017452	034899	052336	069756	087156	104528	121869	139173	156434	60
1	000291	017743	035190	052626	070047	087446	104818	122158	139461	156722	59
2	000582	018034	035481	052917	070337	087735	105107	122447	139749	157009	58
3	000873	018325	035772	053207	070627	088025	105396	122735	140037	157296	57
4	001164	018616	036062	053498	070917	088315	105686	123024	140325	157584	56
5	001454	018907	036353	053788	071207	088605	105975	123313	140613	157871	55
6	001745	019197	036644	054079	071497	088894	106264	123601	140901	158158	54
7	002036	019488	036934	054369	071788	089184	106553	123890	141189	158445	53
8	002327	019779	037225	054660	072078	089474	106843	124179	141477	158732	52
9	002618	020070	037516	054950	072368	089763	107132	124467	141765	159020	51
10	002909	020361	037806	055241	072658	090053	107421	124756	142053	159307	50
11	003200	020652	038097	055531	072948	090343	107710	125045	142341	159594	49
12	003491	020942	038388	055822	073238	090633	107999	125333	142629	159881	48
13	003782	021233	038678	056112	073528	090922	108289	125622	142917	160168	47
14	004072	021524	038969	056402	073818	091212	108578	125910	143205	160455	46
15	004363	021815	039260	056693	074108	091502	108867	126199	143493	160743	45
16	004654	022106	039550	056983	074399	091791	109156	126488	143780	161030	44
17	004945	022397	039841	057274	074689	092081	109445	126776	144068	161317	43
18	005236	022687	040132	057564	074979	092371	109734	127065	144356	161604	42
19	005527	022978	040422	057854	075269	092660	110023	127353	144644	161891	41
20	005818	023269	040713	058145	075559	092950	110313	127642	144932	162178	40
21	006109	023560	041004	058435	075849	093239	110602	127930	145220	162465	39
22	006399	023851	041294	058726	076139	093529	110891	128219	145507	162752	38
23	006690	024141	041585	059016	076429	093819	111180	128507	145795	163039	37
24	006981	024432	041876	059306	076719	094108	111469	128796	146083	163326	36
25	007272	024723	042166	059597	077009	094398	111758	129084	146371	163613	35
26	007563	025014	042457	059887	077299	094687	112047	129373	146659	163900	34
27	007854	025305	042748	060177	077589	094977	112336	129661	146946	164187	33
28	008145	025595	043038	060468	077879	095267	112625	129949	147234	164474	32
29	008436	025886	043329	060758	078169	095556	112914	130238	147522	164761	31
30	008727	026177	043619	061049	078459	095846	113203	130526	147809	165048	30
31	009017	026468	043910	061339	078749	096135	113492	130815	148097	165334	29
32	009308	026759	044201	061629	079039	096425	113781	131103	148385	165621	28
33	009599	027049	044491	061920	079329	096714	114070	131391	148672	165908	27
34	009890	027340	044782	062210	079619	097004	114359	131680	148960	166195	26
35	010181	027631	045072	062500	079909	097293	114648	131968	149248	166482	25
36	010472	027922	045363	062791	080199	097583	114937	132256	149535	166769	24
37	010763	028212	045654	063081	080489	097872	115226	132545	149823	167056	23
38	011054	028503	045944	063371	080779	098162	115515	132833	150111	167342	22
39	011344	028794	046235	063661	081069	098451	115804	133121	150398	167629	21
40	011635	029085	046525	063952	081359	098741	116093	133410	150686	167916	20
41	011926	029375	046816	064242	081649	099030	116382	133698	150973	168203	19
42	012217	029666	047106	064532	081939	099320	116671	133986	151261	168489	18
43	012508	029957	047397	064823	082228	099609	116960	134274	151548	168776	17
44	012799	030248	047688	065113	082518	099899	117249	134563	151836	169063	16
45	013090	030539	047978	065403	082808	100188	117537	134851	152123	169350	15
46	013380	030829	048269	065693	083098	100477	117826	135139	152411	169636	14
47	013671	031120	048559	065984	083388	100767	118115	135427	152698	169923	13
48	013962	031411	048850	066274	083678	101056	118404	135716	152986	170209	12
49	014253	031702	049140	066564	083968	101346	118693	136004	153273	170496	11
50	014544	031992	049431	066854	084258	101635	118982	136292	153561	170783	10
51	014835	032283	049721	067145	084547	101924	119270	136580	153848	171069	9
52	015126	032574	050012	067435	084837	102214	119559	136868	154136	171356	8
53	015416	032864	050302	067725	085127	102503	119848	137156	154423	171643	7
54	015707	033155	050593	068015	085417	102793	120137	137445	154710	171929	6
55	015998	033446	050883	068306	085707	103082	120426	137733	154998	172216	5
56	016289	033737	051174	068596	085997	103371	120714	138021	155285	172502	4
57	016580	034027	051464	068886	086286	103661	121003	138309	155572	172789	3
58	016871	034318	051755	069176	086576	103950	121292	138597	155860	173075	2
59	017162	034609	052045	069466	086866	104239	121581	138885	156147	173362	1
60	017452	034899	052336	069756	087156	104528	121869	139173	156434	173648	0
M	89°	88°	87°	86°	85°	84°	83°	82°	81°	80°	M

Natural Co-sines.

Diff. to 100″	485	485	484	484	483	483	482	481	480	478

TABLE XXVI.—NATURAL SINES.

M	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	M
0	173648	190809	207912	224951	241922	258819	275637	292372	309017	325568	60
1	173935	191095	208196	225234	242204	259100	275917	292650	309294	325843	59
2	174221	191380	208481	225518	242486	259381	276197	292928	309570	326118	58
3	174508	191666	208765	225801	242769	259662	276476	293206	309847	326393	57
4	174794	191951	209050	226085	243051	259943	276756	293484	310123	326668	56
5	175080	192237	209334	226368	243333	260224	277035	293762	310400	326943	55
6	175367	192522	209619	226651	243615	260505	277315	294040	310676	327218	54
7	175653	192807	209903	226935	243897	260785	277594	294318	310953	327493	53
8	175939	193093	210187	227218	244179	261066	277874	294596	311229	327768	52
9	176226	193378	210472	227501	244461	261347	278153	294874	311506	328042	51
10	176512	193664	210756	227784	244743	261628	278432	295152	311782	328317	50
11	176798	193949	211040	228068	245025	261908	278712	295430	312059	328592	49
12	177085	194234	211325	228351	245307	262189	278991	295708	312335	328867	48
13	177371	194520	211609	228634	245589	262470	279270	295986	312611	329141	47
14	177657	194805	211893	228917	245871	262751	279550	296264	312888	329416	46
15	177944	195090	212178	229200	246153	263031	279829	296542	313164	329691	45
16	178230	195376	212462	229484	246435	263312	280108	296819	313440	329965	44
17	178516	195661	212746	229767	246717	263592	280388	297097	313716	330240	43
18	178802	195946	213030	230050	246999	263873	280667	297375	313992	330514	42
19	179088	196231	213315	230333	247281	264154	280946	297653	314269	330789	41
20	179375	196517	213599	230616	247563	264434	281225	297930	314545	331063	40
21	179661	196802	213883	230899	247845	264715	281504	298208	314821	331338	39
22	179947	197087	214167	231182	248126	264995	281783	298486	315097	331612	38
23	180233	197372	214451	231465	248408	265276	282062	298763	315373	331887	37
24	180519	197657	214735	231748	248690	265556	282341	299041	315649	332161	36
25	180805	197942	215019	232031	248972	265837	282620	299318	315925	332435	35
26	181091	198228	215303	232314	249253	266117	282900	299596	316201	332710	34
27	181377	198513	215588	232597	249535	266397	283179	299873	316477	332984	33
28	181663	198798	215872	232880	249817	266678	283457	300151	316753	333258	32
29	181950	199083	216156	233163	250098	266958	283736	300428	317029	333533	31
30	182236	199368	216440	233445	250380	267238	284015	300706	317305	333807	30
31	182522	199653	216724	233728	250662	267519	284294	300983	317580	334081	29
32	182808	199938	217008	234011	250943	267799	284573	301261	317856	334355	28
33	183094	200223	217292	234294	251225	268079	284852	301538	318132	334629	27
34	183379	200508	217575	234577	251506	268359	285131	301815	318408	334903	26
35	183665	200793	217859	234859	251788	268640	285410	302093	318684	335178	25
36	183951	201078	218143	235142	252069	268920	285688	302370	318959	335452	24
37	184237	201363	218427	235425	252351	269200	285967	302647	319235	335726	23
38	184523	201648	218711	235708	252632	269480	286246	302924	319511	336000	22
39	184809	201933	218995	235990	252914	269760	286525	303202	319786	336274	21
40	185095	202218	219279	236273	253195	270040	286803	303479	320062	336547	20
41	185381	202502	219562	236556	253477	270320	287082	303756	320337	336821	19
42	185667	202787	219846	236838	253758	270600	287361	304033	320613	337095	18
43	185952	203072	220130	237121	254039	270880	287639	304310	320889	337369	17
44	186238	203357	220414	237403	254321	271160	287918	304587	321164	337643	16
45	186524	203642	220697	237686	254602	271440	288196	304864	321439	337917	15
46	186810	203927	220981	237968	254883	271720	288475	305141	321715	338190	14
47	187096	204211	221265	238251	255165	272000	288753	305418	321990	338464	13
48	187381	204496	221548	238533	255446	272280	289032	305695	322266	338738	12
49	187667	204781	221832	238816	255727	272560	289310	305972	322541	339012	11
50	187953	205065	222116	239098	256008	272840	289589	306249	322816	339285	10
51	188238	205350	222399	239381	256289	273120	289867	306526	323092	339559	9
52	188524	205635	222683	239663	256571	273400	290145	306803	323367	339832	8
53	188810	205920	222967	239946	256852	273679	290424	307080	323642	340106	7
54	189095	206204	223250	240228	257133	273959	290702	307357	323917	340380	6
55	189381	206489	223534	240510	257414	274239	290981	307633	324193	340653	5
56	189667	206773	223817	240793	257695	274519	291259	307910	324468	340927	4
57	189952	207058	224101	241075	257976	274798	291537	308187	324743	341200	3
58	190238	207343	224384	241357	258257	275078	291815	308464	325018	341473	2
59	190523	207627	224668	241640	258538	275358	292094	308740	325293	341747	1
60	190809	207912	224951	241922	258819	275637	292372	309017	325568	342020	0
M	79°	78°	77°	76°	75°	74°	73°	72°	71°	70°	M
					Natural Co-sines.						
Diff. to 100″	477	475	473	471	469	467	465	462	460	457	

TABLE XXVI.—NATURAL SINES.

M	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	M
0	342020	358368	374607	390731	406737	422618	438371	453990	469472	484810	60
1	342293	358640	374876	390999	407002	422882	438633	454250	469728	485064	59
2	342567	358911	375146	391267	407268	423145	438894	454509	469985	485318	58
3	342840	359183	375416	391534	407534	423409	439155	454768	470242	485573	57
4	343113	359454	375685	391802	407799	423673	439417	455027	470499	485827	56
5	343387	359725	375955	392070	408065	423936	439678	455286	470755	486081	55
6	343660	359997	376224	392337	408330	424199	439939	455545	471012	486335	54
7	343933	360268	376494	392605	408596	424463	440200	455804	471268	486590	53
8	344206	360540	376763	392872	408861	424726	440462	456063	471525	486844	52
9	344479	360811	377033	393140	409127	424990	440723	456322	471782	487098	51
10	344752	361082	377302	393407	409392	425253	440984	456580	472038	487352	50
11	345025	361353	377571	393675	409658	425516	441245	456839	472294	487606	49
12	345298	361625	377841	393942	409923	425779	441506	457098	472551	487860	48
13	345571	361896	378110	394209	410188	426042	441767	457357	472807	488114	47
14	345844	362167	378379	394477	410454	426306	442028	457615	473063	488367	46
15	346117	362438	378649	394744	410719	426569	442289	457874	473320	488621	45
16	346390	362709	378918	395011	410984	426832	442550	458133	473576	488875	44
17	346663	362980	379187	395278	411249	427095	442810	458391	473832	489129	43
18	346936	363251	379456	395546	411514	427358	443071	458650	474088	489382	42
19	347208	363522	379725	395813	411779	427621	443332	458908	474344	489636	41
20	347481	363793	379994	396080	412045	427884	443593	459166	474600	489890	40
21	347754	364064	380263	396347	412310	428147	443853	459425	474856	490143	39
22	348027	364335	380532	396614	412575	428410	444114	459683	475112	490397	38
23	348299	364606	380801	396881	412840	428672	444375	459942	475368	490650	37
24	348572	364877	381070	397148	413104	428935	444635	460200	475624	490904	36
25	348845	365148	381339	397415	413369	429198	444896	460458	475880	491157	35
26	349117	365418	381608	397682	413634	429461	445156	460716	476136	491411	34
27	349390	365689	381877	397949	413899	429723	445417	460974	476392	491664	33
28	349662	365960	382146	398215	414164	429986	445677	461232	476647	491917	32
29	349935	366231	382415	398482	414429	430249	445937	461491	476903	492170	31
30	350207	366501	382683	398749	414693	430511	446198	461749	477159	492424	30
31	350480	366772	382952	399016	414958	430774	446458	462007	477414	492677	29
32	350752	367042	383221	399283	415223	431036	446718	462265	477670	492930	28
33	351025	367313	383490	399549	415487	431299	446979	462523	477925	493183	27
34	351297	367584	383758	399816	415752	431561	447239	462780	478181	493436	26
35	351569	367854	384027	400082	416016	431823	447499	463038	478436	493689	25
36	351842	368125	384295	400349	416281	432086	447759	463296	478692	493942	24
37	352114	368395	384564	400616	416545	432348	448019	463554	478947	494195	23
38	352386	368665	384832	400882	416810	432610	448279	463812	479203	494448	22
39	352658	368936	385101	401149	417074	432873	448539	464069	479458	494700	21
40	352931	369206	385369	401415	417338	433135	448799	464327	479713	494953	20
41	353203	369476	385638	401681	417603	433397	449059	464584	479968	495206	19
42	353475	369747	385906	401948	417867	433659	449319	464842	480223	495459	18
43	353747	370017	386174	402214	418131	433921	449579	465100	480479	495711	17
44	354019	370287	386443	402480	418396	434183	449839	465357	480734	495964	16
45	354291	370557	386711	402747	418660	434445	450098	465615	480989	496217	15
46	354563	370828	386979	403013	418924	434707	450358	465872	481244	496469	14
47	354835	371098	387247	403279	419188	434969	450618	466129	481499	496722	13
48	355107	371368	387516	403545	419452	435231	450878	466387	481754	496974	12
49	355379	371638	387784	403811	419716	435493	451137	466644	482009	497226	11
50	355651	371908	388052	404078	419980	435755	451397	466901	482263	497479	10
51	355923	372178	388320	404344	420244	436017	451656	467158	482518	497731	9
52	356194	372448	388588	404610	420508	436278	451916	467416	482773	497983	8
53	356466	372718	388856	404876	420772	436540	452175	467673	483028	498236	7
54	356738	372988	389124	405142	421036	436802	452435	467930	483282	498488	6
55	357010	373258	389392	405408	421300	437063	452694	468187	483537	498740	5
56	357281	373528	389660	405673	421563	437325	452953	468444	483792	498992	4
57	357553	373797	389928	405939	421827	437587	453213	468701	484046	499244	3
58	357825	374067	390196	406205	422091	437848	453472	468958	484301	499496	2
59	358096	374337	390463	406471	422355	438110	453731	469215	484555	499748	1
60	358368	374607	390731	406737	422618	438371	453990	469472	484810	500000	0
M	69°	68°	67°	66°	65°	64°	63°	62°	61°	60°	M

Natural Co-sines.

Diff. to 100″	454	451	448	445	441	438	434	430	426	422

TABLE XXVI.—NATURAL SINES.

M	30°	31°	32°	33°	34°	35°	36°	37°	38°	39°	M
0	500000	515038	529919	544639	559193	573576	587785	601815	615661	629320	60
1	500252	515287	530166	544883	559434	573815	588021	602047	615891	629546	59
2	500504	515537	530413	545127	559675	574053	588256	602280	616120	629772	58
3	500756	515786	530659	545371	559916	574291	588491	602512	616349	629998	57
4	501007	516035	530906	545615	560157	574529	588726	602744	616578	630224	56
5	501259	516284	531152	545858	560398	574767	588961	602976	616807	630450	55
6	501511	516533	531399	546102	560639	575005	589196	603208	617036	630676	54
7	501762	516782	531645	546346	560880	575243	589431	603440	617265	630902	53
8	502014	517031	531891	546589	561121	575481	589666	603672	617494	631127	52
9	502266	517280	532138	546833	561361	575719	589901	603904	617722	631353	51
10	502517	517529	532384	547076	561602	575957	590136	604136	617951	631578	50
11	502769	517778	532630	547320	561843	576195	590371	604367	618180	631804	49
12	503020	518027	532876	547563	562083	576432	590606	604599	618408	632029	48
13	503271	518276	533122	547807	562324	576670	590840	604831	618637	632255	47
14	503523	518525	533368	548050	562564	576908	591075	605062	618865	632480	46
15	503774	518773	533615	548293	562805	577145	591310	605294	619094	632705	45
16	504025	519022	533861	548536	563045	577383	591544	605526	619322	632931	44
17	504276	519271	534106	548780	563286	577620	591779	605757	619551	633156	43
18	504528	519519	534352	549023	563526	577858	592013	605988	619779	633381	42
19	504779	519768	534598	549266	563766	578095	592248	606220	620007	633606	41
20	505030	520016	534844	549509	564007	578332	592482	606451	620235	633831	40
21	505281	520265	535090	549752	564247	578570	592716	606682	620464	634056	39
22	505532	520513	535335	549995	564487	578807	592951	606914	620692	634281	38
23	505783	520761	535581	550238	564727	579044	593185	607145	620920	634506	37
24	506034	521010	535827	550481	564967	579281	593419	607376	621148	634731	36
25	506285	521258	536072	550724	565207	579518	593653	607607	621376	634955	35
26	506535	521506	536318	550966	565447	579755	593887	607838	621604	635180	34
27	506786	521754	536563	551209	565687	579992	594121	608069	621831	635405	33
28	507037	522002	536809	551452	565927	580229	594355	608300	622059	635629	32
29	507288	522251	537054	551694	566166	580466	594589	608531	622287	635854	31
30	507538	522499	537300	551937	566406	580703	594823	608761	622515	636078	30
31	507789	522747	537545	552180	566646	580940	595057	608992	622742	636303	29
32	508040	522995	537790	552422	566886	581176	595290	609223	622970	636527	28
33	508290	523242	538035	552664	567125	581413	595524	609454	623197	636751	27
34	508541	523490	538281	552907	567365	581650	595758	609684	623425	636976	26
35	508791	523738	538526	553149	567604	581886	595991	609915	623652	637200	25
36	509041	523986	538771	553392	567844	582123	596225	610145	623880	637424	24
37	509292	524234	539016	553634	568083	582359	596458	610376	624107	637648	23
38	509542	524481	539261	553876	568323	582596	596692	610606	624334	637872	22
39	509792	524729	539506	554118	568562	582832	596925	610836	624561	638096	21
40	510043	524977	539751	554360	568801	583069	597159	611067	624789	638320	20
41	510293	525224	539996	554602	569040	583305	597392	611297	625016	638544	19
42	510543	525472	540240	554844	569280	583541	597625	611527	625243	638768	18
43	510793	525719	540485	555086	569519	583777	597858	611757	625470	638992	17
44	511043	525967	540730	555328	569758	584014	598092	611987	625697	639215	16
45	511293	526214	540974	555570	569997	584250	598325	612217	625923	639439	15
46	511543	526461	541219	555812	570236	584486	598558	612447	626150	639663	14
47	511793	526709	541464	556054	570475	584722	598791	612677	626377	639886	13
48	512043	526956	541708	556296	570714	584958	599024	612907	626604	640110	12
49	512293	527203	541953	556537	570952	585194	599256	613137	626830	640333	11
50	512543	527450	542197	556779	571191	585429	599489	613367	627057	640557	10
51	512792	527697	542442	557021	571430	585665	599722	613596	627284	640780	9
52	513042	527944	542686	557262	571669	585901	599955	613826	627510	641003	8
53	513292	528191	542930	557504	571907	586137	600188	614056	627737	641226	7
54	513541	528438	543174	557745	572146	586372	600420	614285	627963	641450	6
55	513791	528685	543419	557987	572384	586608	600653	614515	628189	641673	5
56	514040	528932	543663	558228	572623	586844	600885	614744	628416	641896	4
57	514290	529179	543907	558469	572861	587079	601118	614974	628642	642119	3
58	514539	529426	544151	558710	573100	587314	601350	615203	628868	642342	2
59	514789	529673	544395	558952	573338	587550	601583	615432	629094	642565	1
60	515038	529919	544639	559193	573576	587785	601815	615661	629320	642788	0
M	59°	58°	57°	56°	55°	54°	53°	52°	51°	50°	M
Natural Co-sines.											
Diff. to 100″	418	413	409	404	399	394	390	385	380	374	

TABLE XXVI.—NATURAL SINES

M	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	M
0	642788	656059	669131	681998	694658	707107	719340	731354	743145	754710	60
1	643010	656279	669347	682211	694868	707312	719542	731552	743339	754900	59
2	643233	656408	669563	682424	695077	707518	719744	731750	743534	755091	58
3	643456	656717	669779	682636	695286	707723	719946	731949	743728	755282	57
4	643679	656937	669995	682849	695495	707929	720148	732147	743923	755472	56
5	643901	657156	670211	683061	695704	708134	720349	732345	744117	755663	55
6	644124	657375	670427	683274	695913	708340	720551	732543	744312	755853	54
7	644346	657594	670642	683486	696122	708545	720753	732741	744506	756044	53
8	644569	657814	670858	683698	696330	708750	720954	732939	744700	756234	52
9	644791	658033	671074	683911	696539	708956	721156	733137	744894	756425	51
10	645013	658252	671289	684123	696748	709161	721357	733334	745088	756615	50
11	645236	658471	671505	684335	696957	709366	721559	733532	745282	756805	49
12	645458	658689	671721	684547	697165	709571	721760	733730	745476	756995	48
13	645680	658908	671936	684759	697374	709776	721962	733927	745670	757185	47
14	645902	659127	672151	684971	697582	709981	722163	734125	745864	757375	46
15	646124	659346	672367	685183	697790	710185	722364	734323	746057	757565	45
16	646346	659565	672582	685395	697999	710390	722565	734520	746251	757755	44
17	646568	659783	672797	685607	698207	710595	722766	734717	746445	757945	43
18	646790	660002	673013	685818	698415	710799	722967	734915	746638	758134	42
19	647012	660220	673228	686030	698623	711004	723168	735112	746832	758324	41
20	647233	660439	673443	686242	698832	711209	723369	735309	747025	758514	40
21	647455	660657	673658	686453	699040	711413	723570	735506	747218	758703	39
22	647677	660875	673873	686665	699248	711617	723771	735703	747412	758893	38
23	647898	661094	674088	686876	699455	711822	723971	735900	747605	759082	37
24	648120	661312	674302	687088	699663	712026	724172	736097	747798	759271	36
25	648341	661530	674517	687299	699871	712230	724372	736294	747991	759461	35
26	648563	661748	674732	687510	700079	712434	724573	736491	748184	759650	34
27	648784	661966	674947	687721	700287	712639	724773	736687	748377	759839	33
28	649006	662184	675161	687932	700494	712843	724974	736884	748570	760028	32
29	649227	662402	675376	688144	700702	713047	725174	737081	748763	760217	31
30	649448	662620	675590	688355	700909	713250	725374	737277	748956	760406	30
31	649669	662838	675805	688566	701117	713454	725575	737474	749148	760595	29
32	649890	663056	676019	688776	701324	713658	725775	737670	749341	760784	28
33	650111	663273	676233	688987	701531	713862	725975	737867	749534	760972	27
34	650332	663491	676448	689198	701739	714066	726175	738063	749726	761161	26
35	650553	663709	676662	689409	701946	714269	726375	738259	749919	761350	25
36	650774	663926	676876	689620	702153	714473	726575	738455	750111	761538	24
37	650995	664144	677090	689830	702360	714676	726775	738651	750303	761727	23
38	651216	664361	677304	690041	702567	714880	726974	738848	750496	761915	22
39	651437	664579	677518	690251	702774	715083	727174	739043	750688	762104	21
40	651657	664796	677732	690462	702981	715286	727374	739239	750880	762292	20
41	651878	665013	677946	690672	703188	715490	727573	739435	751072	762480	19
42	652098	665230	678160	690882	703395	715693	727773	739631	751264	762668	18
43	652319	665448	678373	691093	703601	715896	727972	739827	751456	762856	17
44	652539	665665	678587	691303	703808	716099	728172	740023	751648	763044	16
45	652760	665882	678801	691513	704015	716302	728371	740218	751840	763232	15
46	652980	666099	679014	691723	704221	716505	728570	740414	752032	763420	14
47	653200	666316	679228	691933	704428	716708	728769	740609	752223	763608	13
48	653421	666532	679441	692143	704634	716911	728969	740805	752415	763796	12
49	653641	666749	679655	692353	704841	717113	729168	741000	752606	763984	11
50	653861	666966	679868	692563	705047	717316	729367	741195	752798	764171	10
51	654081	667183	680081	692773	705253	717519	729566	741391	752989	764359	9
52	654301	667399	680295	692983	705459	717721	729765	741586	753181	764547	8
53	654521	667616	680508	693192	705665	717924	729963	741781	753372	764734	7
54	654741	667833	680721	693402	705872	718126	730162	741976	753563	764921	6
55	654961	668049	680934	693611	706078	718329	730361	742171	753755	765109	5
56	655180	668265	681147	693821	706284	718531	730560	742366	753946	765296	4
57	655400	668482	681360	694030	706489	718733	730758	742561	754137	765483	3
58	655620	668698	681573	694240	706695	718936	730957	742755	754328	765670	2
59	655839	668914	681786	694449	706901	719138	731155	742950	754519	765857	1
60	656059	669131	681998	694658	707107	719340	731354	743145	754710	766044	0
M	49°	48°	47°	46°	45°	44°	43°	42°	41°	40°	M

Natural Co-sines.

Diff. to 100″	369	363	357	352	346	340	334	327	321	315

TABLE XXVI.—NATURAL SINES.

M	50°	51°	52°	53°	54°	55°	56°	57°	58°	59°	M
0	766044	777146	788011	798636	809017	819152	829038	838671	848048	857167	60
1	766231	777329	788190	798811	809188	819319	829200	838829	848202	857317	59
2	766418	777512	788369	798985	809359	819486	829363	838987	848356	857467	58
3	766605	777695	788548	799160	809530	819652	829525	839146	848510	857616	57
4	766792	777878	788727	799335	809700	819819	829688	839304	848664	857766	56
5	766979	778060	788905	799510	809871	819985	829850	839462	848818	857915	55
6	767165	778243	789084	799685	810042	820152	830012	839620	848972	858065	54
7	767352	778426	789263	799859	810212	820318	830174	839778	849125	858214	53
8	767538	778608	789441	800034	810383	820485	830337	839936	849279	858364	52
9	767725	778791	789620	800208	810553	820651	830499	840094	849433	858513	51
10	767911	778973	789798	800383	810723	820817	830661	840251	849586	858662	50
11	768097	779156	789977	800557	810894	820983	830823	840409	849739	858811	49
12	768284	779338	790155	800731	811064	821149	830984	840567	849893	858960	48
13	768470	779520	790333	800906	811234	821315	831146	840724	850046	859109	47
14	768656	779702	790511	801080	811404	821481	831308	840882	850199	859258	46
15	768842	779884	790690	801254	811574	821647	831470	841039	850352	859406	45
16	769028	780067	790868	801428	811744	821813	831631	841196	850505	859555	44
17	769214	780249	791046	801602	811914	821978	831793	841354	850658	859704	43
18	769400	780430	791224	801776	812084	822144	831954	841511	850811	859852	42
19	769585	780612	791401	801949	812253	822310	832115	841668	850964	860001	41
20	769771	780794	791579	802123	812423	822475	832277	841825	851117	860149	40
21	769957	780976	791757	802297	812592	822641	832438	841982	851269	860297	39
22	770142	781157	791935	802470	812762	822806	832599	842139	851422	860446	38
23	770328	781339	792112	802644	812931	822971	832760	842296	851575	860594	37
24	770513	781520	792290	802817	813101	823136	832921	842452	851727	860742	36
25	770699	781702	792467	802991	813270	823302	833082	842609	851879	860890	35
26	770884	781883	792644	803164	813439	823467	833243	842766	852032	861038	34
27	771069	782065	792822	803337	813608	823632	833404	842922	852184	861186	33
28	771254	782246	792999	803511	813778	823797	833565	843079	852336	861334	32
29	771440	782427	793176	803684	813947	823961	833725	843235	852488	861481	31
30	771625	782608	793353	803857	814116	824126	833886	843391	852640	861629	30
31	771810	782789	793530	804030	814284	824291	834046	843548	852792	861777	29
32	771995	782970	793707	804203	814453	824456	834207	843704	852944	861924	28
33	772179	783151	793884	804376	814622	824620	834367	843860	853096	862072	27
34	772364	783332	794061	804548	814791	824785	834527	844016	853248	862219	26
35	772549	783513	794238	804721	814959	824949	834688	844172	853399	862366	25
36	772734	783693	794415	804894	815128	825113	834848	844328	853551	862514	24
37	772918	783874	794591	805066	815296	825278	835008	844484	853702	862661	23
38	773103	784055	794768	805239	815465	825442	835168	844640	853854	862808	22
39	773287	784235	794944	805411	815633	825606	835328	844795	854005	862955	21
40	773472	784416	795121	805584	815801	825770	835488	844951	854156	863102	20
41	773656	784596	795297	805756	815969	825934	835648	845106	854308	863249	19
42	773840	784776	795473	805928	816138	826098	835807	845262	854459	863396	18
43	774024	784957	795650	806100	816306	826262	835967	845417	854610	863542	17
44	774209	785137	795826	806273	816474	826426	836127	845573	854761	863689	16
45	774393	785317	796002	806445	816642	826590	836286	845728	854912	863836	15
46	774577	785497	796178	896617	816809	826753	836446	845883	855063	863982	14
47	774761	785677	796354	806788	816977	826917	836605	846038	855214	864128	13
48	774944	785857	796530	806960	817145	827081	836764	846193	855364	864275	12
49	775128	786037	796706	807132	817313	827244	836924	846348	855515	864421	11
50	775312	786217	796882	807304	817480	827407	837083	846503	855665	864567	10
51	775496	786396	797057	807475	817648	827571	837242	846658	855816	864713	9
52	775679	786576	797233	807647	817815	827734	837401	846813	855966	864860	8
53	775863	786756	797408	807818	817982	827897	837560	846967	856117	865006	7
54	776046	786935	797584	807990	818150	828060	837719	847122	856267	865151	6
55	776230	787114	797759	808161	818317	828223	837878	847277	856417	865297	5
56	776413	787294	797935	808333	818484	828386	838036	847431	856567	865443	4
57	776596	787473	798110	808504	818651	828549	838195	847585	856718	865589	3
58	776780	787652	798285	808675	818818	828712	838354	847740	856868	865734	2
59	776963	787832	798460	808846	818985	828875	838512	847894	857017	865880	1
60	777146	788011	798636	809017	819152	829038	838671	848048	857167	866025	0
M	39°	38°	37°	36°	35°	34°	33°	32°	31°	30°	M

Natural Co-sines.

Diff. to 100″	309	302	295	288	282	275	268	260	253	246

TABLE XXVI.—NATURAL SINES.

M	60°	61°	62°	63°	64°	65°	66°	67°	68°	69°	M
0	866025	874620	882948	891007	898794	906308	913545	920505	927184	933580	60
1	866171	874761	883084	891139	898922	906431	913664	920618	927293	933685	59
2	866316	874902	883221	891270	899049	906554	913782	920732	927402	933789	58
3	866461	875042	883357	891402	899176	906676	913900	920846	927510	933893	57
4	866607	875183	883493	891534	899304	906799	914018	920959	927619	933997	56
5	866752	875324	883629	891666	899431	906922	914136	921072	927728	934101	55
6	866897	875465	883766	891798	899558	907044	914254	921185	927836	934204	54
7	867042	875605	883902	891929	899685	907166	914372	921299	927945	934308	53
8	867187	875746	884038	892061	899812	907289	914490	921412	928053	934412	52
9	867331	875886	884174	892192	899939	907411	914607	921525	928161	934515	51
10	867476	876026	884309	892323	900065	907533	914725	921638	928270	934619	50
11	867621	876167	884445	892455	900192	907655	914842	921750	928378	934722	49
12	867765	876307	884581	892586	900319	907777	914960	921863	928486	934826	48
13	867910	876447	884717	892717	900445	907899	915077	921976	928594	934929	47
14	868054	876587	884852	892848	900572	908021	915194	922088	928702	935032	46
15	868199	876727	884988	892979	900698	908143	915311	922201	928810	935135	45
16	868343	876867	885123	893110	900825	908265	915429	922313	928917	935238	44
17	868487	877006	885258	893241	900951	908387	915546	922426	929025	935341	43
18	868632	877146	885394	893371	901077	908508	915663	922538	929133	935444	42
19	868776	877286	885529	893502	901203	908630	915779	922650	929240	935547	41
20	868920	877425	885664	893633	901329	908751	915896	922762	929348	935650	40
21	869064	877565	885799	893763	901455	908872	916013	922874	929455	935752	39
22	869207	877704	885934	893894	901581	908994	916130	922986	929562	935855	38
23	869351	877844	886069	894024	901707	909115	916246	923098	929669	935957	37
24	869495	877983	886204	894154	901833	909236	916363	923210	929776	936060	36
25	869639	878122	886338	894284	901958	909357	916479	923322	929884	936162	35
26	869782	878261	886473	894415	902084	909478	916595	923434	929990	936264	34
27	869926	878400	886608	894545	902209	909599	916712	923545	930097	936366	33
28	870069	878539	886742	894675	902335	909720	916828	923657	930204	936468	32
29	870212	878678	886876	894805	902460	909841	916944	923768	930311	936570	31
30	870356	878817	887011	894934	902585	909961	917060	923880	930418	936672	30
31	870499	878956	887145	895064	902710	910082	917176	923991	930524	936774	29
32	870642	879095	887279	895194	902836	910202	917292	924102	930631	936876	28
33	870785	879233	887413	895323	902961	910323	917408	924213	930737	936977	27
34	870928	879372	887548	895453	903086	910443	917523	924324	930843	937079	26
35	871071	879510	887681	895582	903210	910563	917639	924435	930950	937181	25
36	871214	879649	887815	895712	903335	910684	917755	924546	931056	937282	24
37	871357	879787	887949	895841	903460	910804	917870	924657	931162	937383	23
38	871499	879925	888083	895970	903585	910924	917986	924768	931268	937485	22
39	871642	880063	888217	896099	903709	911044	918101	924878	931374	937586	21
40	871784	880201	888350	896229	903834	911164	918216	924989	931480	937687	20
41	871927	880339	888484	896358	903958	911284	918331	925099	931586	937788	19
42	872069	880477	888617	896486	904083	911403	918446	925210	931691	937889	18
43	872212	880615	888751	896615	904207	911523	918561	925320	931797	937990	17
44	872354	880753	888884	896744	904331	911643	918676	925430	931902	938091	16
45	872496	880891	889017	896873	904455	911762	918791	925541	932008	938191	15
46	872638	881028	889150	897001	904579	911881	918906	925651	932113	938292	14
47	872780	881166	889283	897130	904703	912001	919021	925761	932219	938393	13
48	872922	881303	889416	897258	904827	912120	919135	925871	932324	938493	12
49	873064	881441	889549	897387	904951	912239	919250	925980	932429	938593	11
50	873206	881578	889682	897515	905075	912358	919364	926090	932534	938694	10
51	873347	881716	889815	897643	905198	912477	919479	926200	932639	938794	9
52	873489	881853	889948	897771	905322	912596	919593	926310	932744	938894	8
53	873631	881990	890080	897900	905445	912715	919707	926419	932849	938994	7
54	873772	882127	890213	898028	905569	912834	919821	926529	932954	939094	6
55	873914	882264	890345	898156	905692	912953	919936	926638	933058	939194	5
56	874055	882401	890478	898283	905815	913072	920050	926747	933163	939294	4
57	874196	882538	890610	898411	905939	913190	920164	926857	933267	939394	3
58	874338	882674	890742	898539	906062	913309	920277	926966	933372	939493	2
59	874479	882811	890874	898666	906185	913427	920391	927075	933476	939593	1
60	874620	882948	891007	898794	906308	913545	920505	927184	933580	939693	0
M	29°	28°	27°	26°	25°	24°	23°	22°	21°	20°	M

Natural Co-sines.

Diff. to 100″	239	231	221	216	209	201	193	185	178	170

TABLE XXVI.— —NATURAL SINES.

M	70°	71°	72°	73°	74°	75°	76°	77°	78°	79°	M
0	939693	945519	951057	956305	961262	965926	970296	974370	978148	981627	60
1	939792	945613	951146	956390	961342	966001	970366	974435	978208	981683	59
2	939891	945708	951236	956475	961422	966076	970436	974501	978268	981738	58
3	939991	945802	951326	956560	961502	966151	970506	974566	978329	981793	57
4	940090	945897	951415	956644	961582	966226	970577	974631	978389	981849	56
5	940189	945991	951505	956729	961662	966301	970647	974696	978449	981904	55
6	940288	946085	951594	956814	961741	966376	970716	974761	978509	981959	54
7	940387	946180	951684	956898	961821	966451	970786	974826	978569	982014	53
8	940486	946274	951773	956983	961901	966526	970856	974891	978629	982069	52
9	940585	946368	951862	957067	961980	966600	970926	974956	978689	982123	51
10	940684	946462	951951	957151	962059	966675	970995	975020	978748	982178	50
11	940782	946555	952040	957235	962139	966749	971065	975085	978808	982233	49
12	940881	946649	952129	957319	962218	966823	971134	975149	978867	982287	48
13	940979	946743	952218	957404	962297	966898	971204	975214	978927	982342	47
14	941078	946837	952307	957487	962376	966972	971273	975278	978986	982396	46
15	941176	946930	952396	957571	962455	967046	971342	975342	979045	982450	45
16	941274	947024	952484	957655	962534	967120	971411	975406	979105	982505	44
17	941372	947117	952573	957739	962613	967194	971480	975471	979164	982559	43
18	941471	947210	952661	957822	962692	967268	971549	975535	979223	982613	42
19	941569	947304	952750	957906	962770	967342	971618	975598	979282	982667	41
20	941666	947397	952838	957990	962849	967415	971687	975662	979341	982721	40
21	941764	947490	952926	958073	962928	967489	971755	975726	979399	982774	39
22	941862	947583	953015	958156	963006	967562	971824	975790	979458	982828	38
23	941960	947676	953103	958239	963084	967636	971893	975853	979517	982882	37
24	942057	947768	953191	958323	963163	967709	971961	975917	979575	982935	36
25	942155	947861	953279	958406	963241	967782	972030	975980	979634	982989	35
26	942252	947954	953366	958489	963319	967856	972098	976044	979692	983042	34
27	942350	948046	953454	958572	963397	967929	972166	976107	979750	983096	33
28	942447	948139	953542	958654	963475	968002	972234	976170	979809	983149	32
29	942544	948231	953629	958737	963553	968075	972302	976233	979867	983202	31
30	942641	948324	953717	958820	963630	968148	972370	976296	970925	983255	30
31	942739	948416	953804	958902	963708	968220	972438	976359	979983	983308	29
32	942836	948508	953892	958985	963786	968293	972506	976422	980041	983361	28
33	942932	948600	953979	959067	963863	968366	972573	976485	980098	983414	27
34	943029	948692	954066	959150	963941	968438	972641	976547	980156	983466	26
35	943126	948784	954153	959232	964018	968511	972708	976610	980214	983519	25
36	943223	948876	954240	959314	964095	968583	972776	976672	980271	983571	24
37	943319	948968	954327	959396	964173	968656	972843	976735	980329	983624	23
38	943416	949059	954414	959478	964250	968728	972911	976797	980386	983676	22
39	943512	949151	954501	959560	964327	968800	972978	976859	980443	983729	21
40	943609	949243	954588	959642	964404	968872	973045	976921	980500	983781	20
41	943705	949334	954674	959724	964481	968944	973112	976984	980558	983833	19
42	943801	949425	954761	959805	964557	969016	973179	977046	980615	983885	18
43	943897	949517	954847	959887	964634	969088	973246	977108	980672	983937	17
44	943993	949608	954934	959968	964711	969159	973313	977169	980728	983989	16
45	944089	949699	955020	960050	964787	969231	973379	977231	980785	984041	15
46	944185	949790	955106	960131	964864	969302	973446	977293	980842	984092	14
47	944281	949881	955192	960212	964940	969374	973512	977354	980899	984144	13
48	944376	949972	955278	960294	965016	969445	973579	977416	980955	984196	12
49	944472	950063	955364	960375	965093	969517	973645	977477	981012	984247	11
50	944568	950154	955450	960456	965169	969588	973712	977539	981068	984298	10
51	944663	950244	955536	960537	965245	969659	973778	977600	981124	984350	9
52	944758	950335	955622	960618	965321	969730	973844	977661	981181	984401	8
53	944854	950425	955707	960698	965397	969801	973910	977722	981237	984452	7
54	944949	950516	955793	960779	965473	969872	973976	977783	981293	984503	6
55	945044	950606	955879	960860	965548	969943	974042	977844	981349	984554	5
56	945139	950696	955964	960940	965624	970014	974108	977905	981405	984605	4
57	945234	950786	956049	961021	965700	970084	974173	977966	981460	984656	3
58	945329	950877	956134	961101	965775	970155	974239	978026	981516	984707	2
59	945424	950967	956220	961181	965850	970225	974305	978087	981572	984757	1
60	945519	951057	956305	961262	965926	970296	974370	978148	981627	984808	0
M	19°	18°	17°	16°	15°	14°	13°	12°	11°	10°	M

Natural Co-sines.

Diff. to 100″	162	154	146	138	130	121	113	105	97	88

TABLE XXVI.—NATURAL SINES.

M	80°	81°	82°	83°	84°	85°	86°	87°	88°	89°	M
0	984808	987688	990268	992546	994522	996195	997564	998630	999391	999848	60
1	984858	987734	990309	992582	994552	996220	997584	998645	999401	999853	59
2	984909	987779	990349	992617	994583	996245	997604	998660	999411	999858	58
3	984959	987824	990389	992652	994613	996270	997625	998675	999421	999863	57
4	985009	987870	990429	992687	994643	996295	997645	998690	999431	999867	56
5	985059	987915	990469	992722	994673	996320	997664	998705	999441	999872	55
6	985109	987960	990509	992757	994703	996345	997684	998719	999450	999877	54
7	985159	988005	990549	992792	994733	996370	997704	998734	999460	999881	53
8	985209	988050	990589	992827	994762	996395	997724	998749	999469	999886	52
9	985259	988094	990629	992862	994792	996419	997743	998763	999479	999890	51
10	985309	988139	990669	992896	994822	996444	997763	998778	999488	999894	50
11	985358	988184	990708	992931	994851	996468	997782	998792	999497	999808	49
12	985408	988228	990748	992966	994881	996493	997801	998806	999507	999903	48
13	985457	988273	990787	993000	994910	996517	997821	998820	999516	999907	47
14	985507	988317	990827	993034	994939	996541	997840	998834	999525	999910	46
15	985556	988362	990866	993068	994969	996566	997859	998848	999534	999914	45
16	985605	988406	990905	993103	994998	996589	997878	998862	999542	999918	44
17	985654	988450	990944	993137	995027	996614	997897	998876	999551	999922	43
18	985703	988494	990983	993171	995056	996637	997916	998890	999560	999925	42
19	985752	988538	991022	993205	995084	996661	997934	998904	999568	999929	41
20	985801	988582	991061	993238	995113	996685	997953	998917	999577	999932	40
21	985850	988626	991100	993272	995142	996709	997972	998931	999585	999936	39
22	985899	988669	991138	993306	995170	996732	997990	998944	999594	999939	38
23	985947	988713	991177	993339	995199	996756	998008	998957	999602	999942	37
24	985996	988756	991216	993373	995227	996779	998027	998971	999610	999945	36
25	986045	988800	991254	993406	995256	996802	998045	998984	999618	999948	35
26	986093	988843	991292	993439	995284	996825	998063	998997	999626	999951	34
27	986141	988886	991331	993473	995312	996848	998081	999010	999634	999954	33
28	986189	988930	991369	993506	995340	996872	998099	999023	999642	999957	32
29	986238	988973	991407	993539	995368	996894	998117	999035	999650	999959	31
30	986286	989016	991445	993572	995396	996917	998135	999048	999657	999962	30
31	986334	989059	991483	993605	995424	996940	998153	999061	999665	999964	29
32	986381	989102	991521	993638	995452	996963	998170	999073	999672	999967	28
33	986429	989145	991558	993670	995479	996985	998188	999086	999680	999969	27
34	986477	989187	991596	993703	995507	997008	998205	999098	999687	999971	26
35	986525	989230	991634	993735	995535	997030	998223	999111	999694	999974	25
36	986572	989272	991671	993768	995562	997053	998240	999123	999701	999976	24
37	986620	989315	991709	993800	995589	997075	998257	999135	999709	999978	23
38	986667	989357	991746	993833	995617	997097	998274	999147	999716	999980	22
39	986714	989399	991783	993865	995644	997119	998291	999159	999722	999981	21
40	986762	989442	991820	993897	995671	997141	998308	999171	999729	999983	20
41	986809	989484	991857	993929	995698	997163	998325	999183	999736	999985	19
42	986856	989526	991894	993961	995725	997185	998342	999194	999743	999986	18
43	986903	989568	991931	993993	995752	997207	998359	999206	999749	999988	17
44	986950	989610	991968	994025	995778	997229	998375	999218	999756	999989	16
45	986996	989651	992005	994056	995805	997250	998392	999229	999762	999990	15
46	987043	989693	992042	994088	995832	997272	998408	999240	999768	999992	14
47	987090	989735	992078	994120	995858	997293	998425	999252	999775	999993	13
48	987136	989776	992115	994151	995884	997314	998441	999263	999781	999994	12
49	987183	989818	992151	994182	995911	997336	998457	999274	999787	999995	11
50	987229	989859	992187	994214	995937	997357	998473	999285	999793	999996	10
51	987275	989900	992224	994245	995963	997378	998489	999296	999799	999997	9
52	987322	989942	992260	994276	995989	997399	998505	999307	999804	999997	8
53	987368	989983	992296	994307	996015	997420	998521	999318	999810	999998	7
54	987414	990024	992332	994338	996041	997441	998537	999328	999816	999998	6
55	987460	990065	992368	994369	996067	997462	998552	999339	999821	999999	5
56	987506	990105	992404	994400	996093	997482	998568	999350	999827	999999	4
57	987551	990146	992439	994430	996118	997503	998583	999360	999832	1000000	3
58	987597	990187	992475	994461	996144	997523	998599	999370	999837	1000000	2
59	987643	990228	992511	994491	996169	997544	998614	999381	999843	1000000	1
60	987688	990268	992546	994522	996195	997564	998630	999391	999848	1000000	0
M	9°	8°	7°	6°	5°	4°	3°	2°	1°	0°	M

Natural Co-sines.

Diff. to 100″	80	72	63	55	47	38	30	21	13	4	

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

0 Hour.

M	0^{s}	5^{s}	10^{s}	15^{s}	20^{s}	25^{s}	30^{s}	35^{s}	40^{s}	45^{s}	50^{s}	55^{s}	Pro.	ts.
0		43936	13833	96224	83730	74039	66121	59427	53628	48512	43937	39797		
1	2.36018	32542	29324	26328	23525	20892	18410	16061	13834	11715	09695	07764		
2	$\frac{2}{1}$ 05916	04143	02440	00801	99221	97697	96225	94801	93422	92086	90790	89531		
3	1.88307	87118	85959	84831	83732	82660	81613	80591	79593	78617	77663	76729		
4	75815	74919	74042	73182	72339	71512	70700	69903	69121	68352	67597	66855		
5	1.66125	65407	64701	64006	63322	62649	61986	61333	60690	60056	59431	58815		
6	58208	57609	57019	56436	55861	55293	54733	54180	53634	53094	52561	52035		
7	51515	51001	50494	49992	49496	49005	48520	48040	47566	47096	46632	46173		
8	45718	45268	44823	44382	43946	43514	43086	42663	42243	41828	41417	41009		
9	40605	40205	39809	39416	39027	38641	38258	37879	37504	37131	36762	36395		
10	1.36032	35672	35315	34960	34609	34260	33915	33572	33231	32893	32558	32226	s	
11	31896	31568	31243	30921	30600	30282	29967	29653	29342	29034	28727	28422	1	60
12	28120	27820	27522	27225	26931	26639	26349	26061	25774	25490	25207	24926	2	120
13	24647	24370	24095	23821	23549	23279	23010	22743	22478	22214	21952	21691	3	180
14	21433	21175	20919	20665	20412	20160	19910	19662	19415	19169	18925	18682	4	240
15	1.18440	18200	17961	17723	17487	17252	17018	16786	16554	16324	16096	15868	s	
16	15642	15416	15192	14969	14748	14527	14307	14089	13872	13656	13440	13226	1	42
17	13013	12801	12590	12380	12172	11964	11757	11551	11346	11142	10939	10737	2	84
18	10536	10236	10136	09938	09741	09544	09348	09154	08960	08767	08574	08383	3	126
19	08193	08003	07814	07626	07439	07253	07067	06883	06699	06515	06333	06151	4	168
20	1.05970	05790	05611	05432	05254	05077	04901	04725	04550	04376	04202	04029	s	
21	03857	03686	03515	03345	03175	03006	02838	02671	02504	02338	02172	02007	1	32
22	01843	01679	01516	01354	01192	01030	00870	00710	00550	00392	00233	00076	2	65
23	0.99918	99762	99606	99451	99296	99141	98988	98834	98682	98530	98378	98227	3	97
24	98077	97927	97777	97628	97480	97332	97184	97038	96891	96745	96600	96455	4	130
25	0.96310	96167	96023	95880	95738	95596	95454	95313	95172	95032	94892	94753	s	
26	94614	94476	94338	94200	94063	93927	93791	93655	93519	93385	93250	93116	1	26
27	92982	92849	92716	92584	92452	92320	92189	92059	91928	91798	91669	91539	2	53
28	91411	91282	91154	91027	90899	90772	90646	90520	90394	90268	90143	90019	3	79
29	89894	89771	89647	89524	89401	89278	89156	89034	88913	88792	88671	88550	4	106
30	0.88430	88311	88191	88072	87953	87835	87717	87599	87481	87364	87247	87131	s	
31	87015	86899	86783	86668	86553	86438	86324	86210	86096	85983	85870	85757	1	22
32	85645	85532	85420	85309	85197	85086	84976	84865	84755	84645	84535	84426	2	44
33	84317	84208	84100	83992	83884	83776	83669	83561	83455	83348	83242	83136	3	67
34	83030	82924	82819	82714	82609	82505	82401	82297	82193	82089	81986	81883	4	89
35	0.81780	81678	81576	81474	81372	81271	81169	81068	80968	80867	80767	80667	s	
36	80567	80467	80368	80269	80170	80071	79973	79875	79777	79679	79581	79484	1	19
37	79387	79290	79193	79097	79001	78905	78809	78714	78618	78523	78428	78334	2	38
38	78239	78145	78051	77957	77863	77770	77677	77584	77491	77398	77306	77214	3	57
39	77122	77030	76938	76847	76756	76665	76574	76483	76393	76303	76213	76123	4	77
40	0.76033	75944	75854	75765	75676	75588	75499	75411	75323	75235	75147	75059	s	
41	74972	74885	74798	74711	74624	74537	74451	74365	74279	74193	74108	74022	1	17
42	73937	73852	73767	73682	73597	73513	73429	73345	73261	78177	73093	73010	2	34
43	72927	72843	72761	72678	72595	72513	72430	72348	72266	72185	72103	72021	3	51
44	71940	71859	71778	71697	71616	71536	71456	71375	71295	71215	71136	71056	4	68
45	0.70976	70897	70818	70739	70660	70581	70503	70424	70346	70268	70190	70112	s	
46	70035	69957	69880	69802	69725	69648	69571	69495	69418	69342	69265	69189	1	15
47	69113	69038	68962	68886	68811	68735	68660	68585	68510	68436	68361	68287	2	30
48	68212	68138	68064	67990	67916	67842	67769	67695	67622	67549	67476	67403	3	45
49	67330	67257	67185	67112	67040	66968	66896	66824	66752	66681	66609	66538	4	60
50	0.66466	66395	66324	66253	66182	66112	66041	65971	65900	65830	65760	65690	s	
51	65620	65551	65481	65411	65342	65273	65204	65135	65066	64997	64928	64860	1	14
52	64791	64723	64655	64587	64519	64451	64383	64315	64248	64180	64113	64046	2	27
53	63979	63912	63845	63778	63711	63645	63578	63512	63445	63379	63313	63247	3	41
54	63182	63116	63050	62985	62919	62854	62789	62724	62659	62594	62529	62464	4	54
55	0.62400	62335	62271	62207	62142	62078	62014	61950	61887	61823	61759	61696	s	
56	61633	61569	61506	61443	61380	61317	61254	61192	61129	61066	61004	60942	1	12
57	60879	60817	60755	60693	60632	60570	60508	60447	60385	60324	60262	60201	2	25
58	60140	60079	60018	59957	59897	59836	59775	59715	59655	59594	59534	59474	3	37
59	59414	59354	59294	59234	59175	59115	59056	58996	58937	58878	58818	58759	4	50

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

1 Hour.

M	0ˢ	5ˢ	10ˢ	15ˢ	20ˢ	25ˢ	30ˢ	35ˢ	40ˢ	45ˢ	50ˢ	55ˢ	Pro.pts.	
0	0.58700	58642	58583	58524	58465	58407	58348	58290	58232	58173	58115	58057	s	
1	57999	57941	57884	57826	57768	57711	57653	57596	57539	57481	57424	57367	1	11
2	57310	57253	57196	57140	57083	57026	56970	56914	56857	56801	56745	56689	2	22
3	56633	56577	56521	56465	56409	56354	56298	56243	56187	56132	56077	56021	3	34
4	55966	55911	55856	55801	55747	55692	55637	55583	55528	55474	55419	55365	4	45
5	0.55311	55257	55203	55149	55095	55041	54987	54933	54880	54826	54773	54719	s	
6	54666	54613	54559	54506	54453	54400	54347	54294	54242	54189	54136	54084	1	10
7	54031	53979	53926	53874	53822	53770	53718	53666	53614	53562	53510	53458	2	21
8	53407	53355	53303	53252	53200	53149	53098	53047	52995	52944	52893	52842	3	31
9	52791	52741	52690	52639	52589	52538	52488	52437	52387	52336	52286	52236	4	42
10	0.52186	52136	52086	52036	51986	51936	51887	51837	51787	51738	51688	51639	s	
11	51589	51540	51491	51442	51393	51344	51295	51246	51197	51148	51099	51050	1	10
12	51002	50953	50905	50856	50808	50760	50711	50663	50615	50567	50519	50471	2	19
13	50423	50375	50327	50279	50232	50184	50137	50089	50042	49994	49947	49900	3	29
14	49852	49805	49758	49711	49664	49617	49570	49523	49477	49430	49383	49337	4	38
15	0.49290	49244	49197	49151	49104	49058	49012	48966	48920	48874	48828	48782	s	
16	48736	48690	48644	48599	48553	48507	48462	48416	48371	48325	48280	48235	1	9
17	48189	48144	48099	48054	48009	47964	47919	47874	47829	47785	47740	47695	2	18
18	47651	47606	47561	47517	47473	47428	47384	47340	47295	47251	47207	47163	3	27
19	47119	47075	47031	46987	46944	46900	46856	46812	46769	46725	46682	46638	4	36
20	0.46595	46552	46508	46465	46422	46379	46335	46292	46249	46206	46163	46121	s	
21	46078	46035	45992	45950	45907	45864	45822	45779	45737	45694	45652	45610	1	8
22	45568	45525	45483	45441	45399	45357	45315	45273	45231	45189	45147	45106	2	17
23	45064	45022	44981	44939	44898	44856	44815	44773	44732	44691	44650	44608	3	25
24	44567	44526	44485	44444	44403	44362	44321	44280	44239	44199	44158	44117	4	34
25	0.44077	44036	43996	43955	43915	43874	43834	43793	43753	43713	43673	43633	s	
26	43593	43552	43512	43472	43432	43393	43353	43313	43273	43233	43194	43154	1	8
27	43115	43075	43035	42996	42957	42917	42878	42838	42799	42760	42721	42682	2	16
28	42643	42603	42564	42525	42486	42448	42409	42370	42331	42292	42254	42215	3	24
29	42176	42138	42099	42061	42022	41984	41946	41907	41869	41831	41792	41754	4	32
30	0.41716	41678	41640	41602	41564	41526	41488	41450	41412	41375	41337	41299	s	
31	41261	41224	41186	41149	41111	41074	41036	40999	40961	40924	40887	40849	1	7
32	40812	40775	40738	40701	40664	40627	40590	40553	40516	40479	40442	40405	2	15
33	40369	40332	40295	40258	40222	40185	40149	40112	40076	40039	40003	39966	3	22
34	39930	39894	39858	39821	39785	39749	39713	39677	39641	39605	39569	39533	4	30
35	0.39497	39461	39425	39389	39354	39318	39282	39247	39211	39175	39140	39104	s	
36	39069	39033	38998	38962	38927	38892	38857	38821	38786	38751	38716	38681	1	7
37	38646	38611	38576	38541	38506	38471	38436	38401	38366	38331	38297	38262	2	14
38	38227	38193	38158	38124	38089	38055	38020	37986	37951	37917	37883	37848	3	21
39	37814	37780	37745	37711	37677	37643	37609	37575	37541	37507	37473	37439	4	28
40	0.37405	37371	37338	37304	37270	37236	37203	37169	37135	37102	37068	37035	s	
41	37001	36968	36934	36901	36867	36834	36801	36768	36734	36701	36668	36635	1	7
42	36602	36569	36535	36502	36469	36436	36404	36371	36338	36305	36272	36239	2	13
43	36207	36174	36141	36108	36076	36043	36011	35978	35946	35913	35881	35848	3	20
44	35816	35783	35751	35719	35687	35654	35622	35590	35558	35526	35494	35462	4	26
45	0.35429	35397	35365	35334	35302	35270	35238	35206	35174	35142	35111	35079	s	
46	35047	35016	34984	34952	34921	34889	34858	34826	34795	34763	34732	34701	1	6
47	34669	34638	34607	34575	34544	34513	34482	34451	34420	34388	34357	34326	2	12
48	34295	34264	34233	34203	34172	34141	34110	34079	34048	34018	33987	33956	3	19
49	33925	33895	33864	33834	33803	33773	33742	33712	33681	33651	33620	33590	4	25
50	0.33559	33529	33499	33469	33438	33408	33378	33348	33318	33288	33257	33227	s	
51	33197	33167	33137	33107	33078	33048	33018	32988	32958	32928	32899	32869	1	6
52	32839	32809	32780	32750	32721	32691	32661	32632	32602	32573	32543	32514	2	12
53	32485	32455	32426	32397	32367	32338	32309	32280	32250	32221	32192	32163	3	18
54	32134	32105	32076	32047	32018	31989	31960	31931	31902	31873	31844	31815	4	24
55	0.31787	31758	31729	31700	31672	31643	31614	31586	31557	31529	31500	31471	s	
56	31443	31414	31386	31358	31329	31301	31272	31244	31216	31188	31159	31131	1	6
57	31103	31075	31046	31018	30990	30962	30934	30906	30878	30850	30822	30794	2	12
58	30766	30738	30710	30683	30655	30627	30599	30571	30544	30516	30488	30461	3	17
59	30433	30405	30378	30350	30323	30295	30268	30240	30213	30185	30158	30130	4	23

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

2 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Prc. pts.	
0	0.30103	30076	30048	30021	29994	29967	29939	29912	29885	29858	29831	29804	s	
1	29776	29749	29722	29695	29668	29641	29614	29587	29561	29534	29507	29480	1	5
2	29453	29426	29400	29373	29346	29319	29293	29266	29239	29213	29186	29160	2	10
3	29133	29107	29080	29054	29027	29001	28974	28948	28921	28895	28869	28842	3	16
4	28816	28790	28764	28737	28711	28685	28659	28633	28607	28580	28554	28528	4	21
5	0.28502	28476	28450	28424	28398	28372	28347	28321	28295	28269	28243	28217	s	
6	28192	28166	28140	28114	28089	28063	28037	28012	27986	27960	27935	27909	1	5
7	27884	27858	27833	27807	27782	27756	27731	27706	27680	27655	27630	27604	2	10
8	27579	27554	27529	27503	27478	27453	27428	27403	27378	27352	27327	27302	3	15
9	27277	27252	27227	27202	27177	27152	27127	27103	27078	27053	27028	27003	4	20
10	0.26978	26954	26929	26904	26879	26855	26830	26805	26781	26756	26732	26707	s	
11	26682	26658	26633	26609	26584	26560	26535	26511	26487	26462	26438	26414	1	5
12	26389	26365	26341	26316	26292	26268	26244	26219	26195	26171	26147	26123	2	10
13	26099	26075	26051	26027	26003	25979	25955	25931	25907	25883	25859	25835	3	14
14	25811	25787	25763	25740	25716	25692	25668	25645	25621	25597	25573	25550	4	19
15	0.25526	25503	25479	25455	25432	25408	25385	25361	25338	25314	25291	25267	s	
16	25244	25220	25197	25174	25150	25127	25104	25080	25057	25034	25011	24987	1	5
17	24964	24941	24918	24895	24872	24849	24825	24802	24779	24756	24733	24710	2	9
18	24687	24664	24641	24618	24595	24573	24550	24527	24504	24481	24458	24436	3	14
19	24413	24390	24367	24345	24322	24299	24277	24254	24231	24209	24186	24163	4	18
20	0.24141	24118	24096	24073	24051	24028	24006	23983	23961	23939	23916	23894	s	
21	23872	23849	23827	23805	23782	23760	23738	23716	23693	23671	23649	23627	1	4
22	23605	23583	23560	23538	23516	23494	23472	23450	23428	23406	23384	23362	2	9
23	23340	23318	23296	23274	23253	23231	23209	23187	23165	23143	23122	23100	3	13
24	23078	23056	23035	23013	22991	22970	22948	22926	22905	22883	22862	22840	4	18
25	0.22819	22797	22776	22754	22733	22711	22690	22668	22647	22625	22604	22583	s	
26	22561	22540	22519	22497	22476	22455	22434	22412	22391	22370	22349	22328	1	4
27	22306	22285	22264	22243	22222	22201	22180	22159	22138	22117	22096	22075	2	8
28	22054	22033	22012	21991	21970	21949	21928	21907	21887	21866	21845	21824	3	13
29	21803	21783	21762	21741	21720	21700	21679	21658	21638	21617	21597	21576	4	17
30	0.21555	21535	21514	21494	21473	21453	21432	21412	21391	21371	21350	21330	s	
31	21309	21289	21269	21248	21228	21208	21187	21167	21147	21127	21106	21086	1	4
32	21066	21046	21025	21005	20985	20965	20945	20925	20905	20885	20864	20844	2	8
33	20824	20804	20784	20764	20744	20724	20704	20685	20665	20645	20625	20605	3	12
34	20585	20565	20545	20526	20506	20486	20466	20446	20427	20407	20387	20368	4	16
35	0.20348	20328	20309	20289	20269	20250	20230	20211	20191	20171	20152	20132	s	
36	20113	20093	20074	20054	20035	20016	19996	19977	19957	19938	19919	19899	1	4
37	19880	19861	19841	19822	19803	19783	19764	19745	19726	19707	19687	19668	2	8
38	19649	19630	19611	19592	19572	19553	19534	19515	19496	19477	19458	19439	3	11
39	19420	19401	19382	19363	19344	19325	19306	19288	19269	19250	19231	19212	4	15
40	0.19192	19174	19156	19137	19118	19099	19081	19062	19043	19024	19006	18987	s	
41	18968	18950	18931	18913	18894	18875	18857	18838	18820	18801	18783	18764	1	4
42	18746	18727	18709	18690	18672	18653	18635	18617	18598	18580	18561	18543	2	7
43	18525	18506	18488	18470	18452	18433	18415	18397	18379	18360	18342	18324	3	11
44	18306	18288	18269	18251	18233	18215	18197	18179	18161	18143	18125	18107	4	14
45	0.18089	18071	18053	18035	18017	17999	17981	17963	17945	17927	17909	17891	s	
46	17874	17856	17838	17820	17802	17785	17767	17749	17731	17713	17696	17678	1	4
47	17660	17643	17625	17607	17590	17572	17554	17537	17519	17502	17484	17467	2	7
48	17449	17431	17414	17396	17379	17361	17344	17327	17309	17292	17274	17257	3	11
49	17239	17222	17205	17187	17170	17153	17135	17118	17101	17083	17066	17049	4	14
50	0.17032	17014	16997	16980	16963	16946	16929	16911	16894	16877	16860	16843	s	
51	16826	16809	16792	16775	16758	16741	16724	16707	16690	16673	16656	16639	1	3
52	16622	16605	16588	16571	16554	16537	16520	16503	16487	16470	16453	16436	2	7
53	16419	16403	16386	16369	16352	16336	16319	16302	16285	16269	16252	16235	3	10
54	16219	16202	16186	16169	16152	16136	16119	16103	16086	16070	16053	16037	4	14
55	0.16020	16004	15987	15971	15954	15938	15921	15905	15888	15872	15856	15839	s	
56	15823	15807	15790	15774	15758	15741	15725	15709	15692	15676	15660	15644	1	3
57	15628	15611	15595	15579	15563	15547	15531	15514	15498	15482	15466	15450	2	6
58	15434	15418	15402	15386	15370	15354	15338	15322	15306	15290	15274	15258	3	10
59	15242	15226	15210	15194	15178	15162	15147	15131	15115	15099	15083	15067	4	13

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

3 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	0.15052	15036	15020	15004	14988	14973	14957	14941	14926	14910	14894	14879	s	
1	14863	14847	14832	14816	14800	14785	14769	14754	14738	14722	14707	14691	1	3
2	14676	14660	14645	14629	14614	14598	14583	14567	14552	14537	14521	14506	2	6
3	14490	14475	14460	14444	14429	14414	14398	14383	14368	14352	14337	14322	3	10
4	14307	14291	14276	14261	14246	14231	14215	14200	14185	14170	14155	14140	4	13
5	0.14124	14109	14094	14079	14064	14049	14034	14019	14004	13989	13974	13959	s	
6	13944	13929	13914	13899	13884	13869	13854	13839	13824	13809	13795	13780	1	3
7	13765	13750	13735	13720	13705	13691	13676	13661	13646	13632	13617	13602	2	6
8	13587	13573	13558	13543	13528	13514	13499	13484	13470	13455	13441	13426	3	9
9	13411	13397	13382	13368	13353	13339	13324	13309	13295	13280	13266	13251	4	12
10	0.13237	13223	13208	13194	13179	13165	13150	13136	13122	13107	13093	13078	s	
11	13064	13050	13035	13021	13007	12992	12978	12964	12950	12935	12921	12907	1	3
12	12893	12878	12864	12850	12836	12822	12808	12793	12779	12765	12751	12737	2	6
13	12723	12709	12695	12681	12667	12652	12638	12624	12610	12596	12582	12568	3	8
14	12554	12540	12527	12513	12499	12485	12471	12457	12443	12429	12415	12401	4	11
15	0.12388	12374	12360	12346	12332	12318	12305	12291	12277	12263	12250	12236	s	
16	12222	12208	12195	12181	12167	12154	12140	12126	12113	12099	12085	12072	1	3
17	12058	12044	12031	12017	12004	11990	11977	11963	11950	11936	11922	11909	2	5
18	11896	11882	11869	11855	11842	11828	11815	11801	11788	11775	11761	11748	3	8
19	11734	11721	11708	11694	11681	11668	11654	11641	11628	11614	11601	11588	4	10
20	0.11575	11561	11548	11535	11522	11509	11495	11482	11469	11456	11443	11429	s	
21	11416	11403	11390	11377	11364	11351	11338	11325	11312	11299	11286	11272	1	3
22	11259	11246	11233	11220	11207	11194	11182	11169	11156	11143	11130	11117	2	5
23	11104	11091	11078	11065	11052	11040	11027	11014	11001	10988	10975	10963	3	8
24	10950	10937	10924	10911	10899	10886	10873	10861	10848	10835	10822	10810	4	10
25	0.10797	10784	10772	10759	10746	10734	10721	10709	10696	10683	10671	10658	s	
26	10646	10633	10621	10608	10595	10583	10570	10558	10545	10533	10520	10508	1	2
27	10496	10483	10471	10458	10446	10433	10421	10409	10396	10384	10372	10359	2	5
28	10347	10335	10322	10310	10298	10285	10273	10261	10248	10236	10224	10212	3	7
29	10199	10187	10175	10163	10151	10138	10126	10114	10102	10090	10078	10066	4	10
30	0.10053	10041	10029	10017	10005	09993	09981	09969	09957	09945	09933	09921	s	
31	09909	09897	09885	09873	09861	09849	09837	09825	09813	09801	09789	09777	1	2
32	09765	09753	09741	09730	09718	09706	09694	09682	09670	09658	09647	09635	2	5
33	09623	09611	09599	09588	09576	09564	09552	09541	09529	09517	09506	09494	3	7
34	09482	09471	09459	09447	09436	09424	09412	09401	09389	09377	09366	09354	4	10
35	0.09343	09331	09319	09308	09296	09285	09273	09262	09250	09239	09227	09216	s	
36	09204	09193	09181	09170	09158	09147	09136	09124	09113	09101	09090	09079	1	2
37	09067	09056	09045	09033	09022	09011	08999	08988	08977	08965	08954	08943	2	4
38	08931	08920	08909	08898	08886	08875	08864	08853	08842	08830	08819	08808	3	7
39	08797	08786	08775	08763	08752	08741	08730	08719	08708	08697	08686	08675	4	9
40	0.08664	08653	08642	08630	08619	08608	08597	08586	08575	08564	08553	08542	s	
41	08532	08521	08510	08499	08488	08477	08466	08455	08444	08133	08422	08412	1	2
42	08401	08390	08379	08368	08357	08347	08336	08325	08314	08303	08293	08282	2	4
43	08271	08260	08250	08239	08228	08217	08207	08196	08185	08175	08164	08153	3	7
44	08143	08132	08121	08111	08100	08089	08079	08068	08058	08047	08037	08026	4	9
45	0.08015	08005	07994	07984	07973	07963	07952	07942	07931	07921	07910	07900	s	
46	07889	07879	07869	07858	07848	07837	07827	07816	07806	07796	07785	07775	1	2
47	07765	07754	07744	07734	07723	07713	07703	07692	07682	07672	07661	07651	2	4
48	07641	07631	07620	07610	07600	07590	07580	07569	07559	07549	07539	07529	3	6
49	07518	07508	07498	07488	07478	07468	07458	07448	07437	07427	07417	07407	4	8
50	0.07397	07387	07377	07367	07357	07347	07337	07327	07317	07307	07297	07287	s	
51	07277	07267	07257	07247	07237	07227	07217	07207	07198	07188	07178	07168	1	2
52	07158	07148	07138	07128	07119	07109	07099	07089	07079	07070	07060	07050	2	4
53	07040	07030	07021	07011	07001	06991	06982	06972	06962	06953	06943	06933	3	6
54	06923	06914	06904	06894	06885	06875	06866	06856	06846	06837	06827	06818	4	8
55	0.06808	06798	06789	06779	06770	06760	06751	06741	06732	06722	06712	06703	s	
56	06693	06684	06675	06665	06656	06646	06637	06627	06618	06608	06599	06590	1	2
57	06580	06571	06561	06552	06543	06533	06524	06515	06505	06496	06487	06477	2	4
58	06468	06459	06449	06440	06431	06422	06412	06403	06391	06385	06375	06366	3	6
59	06357	06348	06339	06329	06320	06311	06302	06293	06284	06274	06265	06256	4	8

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

4 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	0.06247	06238	06229	06220	06211	06202	06192	06183	06174	06165	06156	06147	s	
1	06138	06129	06120	06111	06102	06093	06084	06075	06066	06057	06048	06039	1	2
2	06030	06021	06013	06004	05995	05986	05977	05968	05959	05950	05941	05933	2	4
3	05924	05915	05906	05897	05888	05880	05871	05862	05853	05844	05836	05827	3	5
4	05818	05809	05801	05792	05783	05774	05766	05757	05748	05740	05731	05722	4	7
5	0.05714	05705	05696	05688	05679	05670	05662	05653	05645	05636	05627	05619	s	
6	05610	05602	05593	05585	05576	05567	05559	05550	05542	05533	05525	05516	1	2
7	05508	05499	05491	05482	05474	05466	05457	05449	05440	05432	05423	05415	2	4
8	05407	05398	05390	05381	05373	05365	05356	05348	05340	05331	05323	05315	3	5
9	05306	05298	05290	05281	05273	05265	05257	05248	05240	05232	05224	05215	4	7
10	0.05207	05199	05191	05183	05174	05166	05158	05150	05142	05133	05125	05117	s	
11	05109	05101	05093	05085	05077	05068	05060	05052	05044	05036	05028	05020	1	2
12	05012	05004	04996	04988	04980	04972	04964	04956	04948	04940	04932	04924	2	3
13	04916	04908	04900	04892	04884	04876	04868	04860	04852	04845	04837	04829	3	5
14	04821	04813	04805	04797	04790	04782	04774	04766	04758	04750	04743	04735	4	6
15	0.04727	04719	04711	04704	04696	04688	04680	04673	04665	04657	04649	04642	s	
16	04634	04626	04619	04611	04603	04596	04588	04580	04573	04565	04557	04550	1	2
17	04542	04535	04527	04519	04512	04504	04497	04489	04481	04474	04466	04459	2	3
18	04451	04444	04436	04429	04421	04414	04406	04399	04391	04384	04376	04369	3	5
19	04361	04354	04346	04339	04332	04324	04317	04309	04302	04295	04287	04280	4	6
20	0.04272	04265	04258	04250	04243	04236	04228	04221	04214	04206	04199	04192	s	
21	04185	04177	04170	04163	04156	04148	04141	04134	04127	04119	04112	04105	1	1
22	04098	04091	04083	04076	04069	04062	04055	04048	04040	04033	04026	04019	2	3
23	04012	04005	03998	03991	03984	03976	03969	03962	03955	03948	03941	03934	3	4
24	03927	03920	03913	03906	03899	03892	03885	03878	03871	03864	03857	03850	4	6
25	0.03843	03836	03829	03822	03815	03809	03802	03795	03788	03781	03774	03767	s	
26	03760	03753	03747	03740	03733	03726	03719	03712	03706	03699	03692	03685	1	1
27	03678	03672	03665	03658	03651	03645	03638	03631	03624	03618	03611	03604	2	3
28	03597	03591	03584	03577	03571	03564	03557	03551	03544	03537	03531	03524	3	4
29	03517	03511	03504	03498	03491	03484	03478	03471	03465	03458	03452	03445	4	6
30	0.03439	03432	03425	03419	03412	03406	03399	03393	03386	03380	03373	03367	s	
31	03361	03354	03348	03341	03335	03328	03322	03315	03309	03303	03296	03290	1	1
32	03283	03277	03271	03264	03258	03252	03245	03239	03233	03226	03220	03214	2	2
33	03207	03201	03195	03189	03182	03176	03170	03163	03157	03151	03145	03138	3	4
34	03132	03126	03120	03114	03107	03101	03095	03089	03083	03077	03070	03064	4	5
35	0.03058	03052	03046	03040	03034	03027	03021	03015	03009	03003	02997	02991	s	
36	02985	02979	02973	02967	02961	02955	02949	02943	02937	02931	02925	02919	1	1
37	02913	02907	02901	02895	02889	02883	02877	02871	02865	02859	02853	02847	2	2
38	02841	02835	02829	02824	02818	02812	02806	02800	02794	02788	02783	02777	3	4
39	02771	02765	02759	02753	02748	02742	02736	02730	02725	02719	02713	02767	4	5
40	0.02701	02696	02690	02684	02679	02673	02667	02661	02656	02650	02644	02639	s	
41	02633	02627	02622	02616	02610	02605	02599	02593	02588	02582	02577	02571	1	1
42	02565	02560	02554	02549	02543	02538	02532	02526	02521	02515	02510	02504	2	2
43	02499	02493	02488	02482	02477	02471	02466	02460	02455	02449	02444	02438	3	3
44	02433	02428	02422	02417	02411	02406	02401	02395	02390	02384	02379	02374	4	4
45	0.02368	02363	02358	02352	02347	02342	02336	02331	02326	02320	02315	02310	s	
46	02304	02299	02294	02289	02283	02278	02273	02268	02262	02257	02252	02247	1	1
47	02241	02236	02231	02226	02221	02215	02210	02205	02200	02195	02190	02185	2	2
48	02179	02174	02169	02164	02159	02154	02149	02144	02139	02134	02128	02123	3	3
49	02118	02113	02108	02103	02098	02093	02088	02083	02078	02073	02068	02063	4	4
50	0.02058	02053	02048	02043	02038	02033	02028	02023	02018	02014	02009	02004	s	
51	01999	01994	01989	01984	01979	01974	01970	01965	01960	01955	01950	01945	1	1
52	01940	01936	01931	01926	01921	01916	01912	01907	01902	01897	01892	01888	2	2
53	01883	01878	01873	01869	01864	01859	01855	01850	01845	01840	01836	01831	3	3
54	01826	01822	01817	01812	01808	01803	01798	01794	01789	01785	01780	01775	4	4
55	0.01771	01766	01761	01757	01752	01748	01743	01739	01734	01730	01725	01720	s	
56	01716	01711	01707	01702	01698	01693	01689	01684	01680	01675	01671	01666	1	1
57	01662	01658	01653	01649	01644	01640	01635	01631	01627	01622	01618	01613	2	2
58	01609	01605	01600	01596	01592	01587	01583	01578	01574	01570	01566	01561	3	2
59	01557	01553	01548	01544	01540	01535	01531	01527	01523	01518	01514	01510	4	3

TABLE XXVII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

HALF ELAPSED TIME.

5 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	0.01506	01501	01497	01493	01489	01485	01480	01476	01472	01468	01464	01460	s	
1	01455	01451	01447	01443	01439	01435	01431	01426	01422	01418	01414	01410	1	1
2	01406	01402	01398	01394	01390	01386	01382	01377	01373	01369	01365	01361	2	2
3	01357	01353	01349	01345	01341	01337	01333	01329	01325	01321	01318	01314	3	2
4	01310	01306	01302	01298	01294	01290	01286	01282	01278	01274	01271	01267	4	3
5	0.01263	01259	01255	01251	01247	01244	01240	01236	01232	01228	01224	01221	s	
6	01217	01213	01209	01206	01202	01198	01194	01191	01187	01183	01179	01176	1	1
7	01172	01168	01164	01161	01157	01153	01150	01146	01142	01139	01135	01131	2	2
8	01128	01124	01120	01117	01113	01110	01106	01102	01099	01095	01092	01088	3	2
9	01084	01081	01077	01074	01070	01067	01063	01059	01056	01052	01049	01045	4	3
10	0.01042	01038	01035	01031	01028	01024	01021	01018	01014	01011	01007	01004	s	
11	01000	00997	00993	00990	00987	00983	00980	00976	00973	00970	00966	00963	1	1
12	00960	00956	00953	00950	00946	00943	00940	00936	00933	00930	00926	00923	2	1
13	00920	00916	00913	00910	00907	00903	00900	00897	00894	00890	00887	00884	3	2
14	00881	00878	00874	00871	00868	00865	00862	00858	00855	00852	00849	00846	4	2
15	0.00843	00840	00836	00833	00830	00827	00824	00821	00818	00815	00812	00808	s	
16	00805	00802	00799	00796	00793	00790	00787	00784	00781	00778	00775	00772	1	1
17	00769	00766	00763	00760	00757	00754	00751	00748	00745	00742	00739	00736	2	1
18	00733	00731	00728	00725	00722	00719	00716	00713	00710	00707	00704	00702	3	2
19	00699	00696	00693	00690	00687	00685	00682	00679	00676	00673	00670	00668	4	2
20	0.00665	00662	00659	00657	00654	00651	00648	00646	00643	00640	00637	00635	s	
21	00632	00629	00627	00624	00621	00618	00616	00613	00610	00608	00605	00602	1	1
22	00600	00597	00595	00592	00589	00587	00584	00581	00579	00576	00574	00571	2	1
23	00568	00566	00563	00561	00558	00556	00553	00551	00548	00546	00543	00541	3	2
24	00538	00536	00533	00531	00528	00526	00523	00521	00518	00516	00513	00511	4	2
25	0.00508	00506	00504	00501	00499	00496	00494	00492	00489	00487	00484	00482	s	
26	00480	00477	00475	00473	00470	00468	00466	00463	00461	00459	00456	00454	1	0
27	00452	00450	00447	00445	00443	00440	00438	00436	00434	00431	00429	00427	2	1
28	00425	00423	00420	00418	00416	00414	00412	00409	00407	00405	00403	00401	3	1
29	00399	00396	00394	00392	00390	00388	00386	00384	00382	00379	00377	00375	4	2
30	0.00373	00371	00369	00367	00365	00363	00361	00359	00357	00355	00353	00351	s	
31	00349	00347	00345	00343	00341	00339	00337	00335	00333	00331	00329	00327	1	0
32	00325	00323	00321	00319	00317	00315	00313	00312	00310	00308	00306	00304	2	1
33	00302	00300	00298	00297	00295	00293	00291	00289	00287	00286	00284	00282	3	1
34	00280	00278	00277	00275	00273	00271	00269	00267	00266	00264	00262	00261	4	2
35	0.00259	00257	00256	00254	00252	00250	00249	00247	00245	00244	00242	00240	s	
36	00239	00237	00235	00234	00232	00230	00229	00227	00226	00224	00222	00221	1	0
37	00219	00218	00216	00214	00213	00211	00210	00208	00207	00205	00204	00202	2	1
38	00200	00199	00197	00196	00194	00193	00191	00190	00188	00187	00186	00184	3	1
39	00183	00181	00180	00178	00177	00175	00174	00173	00171	00170	00168	00167	4	2
40	0.00166	00164	00163	00162	00160	00159	00157	00156	00155	00153	00152	00151	s	
41	00149	00148	00147	00146	00144	00143	00142	00140	00139	00138	00137	00135	1	0
42	00134	00133	00132	00130	00129	00128	00127	00126	00124	00123	00122	00121	2	0
43	00120	00118	00117	00116	00115	00114	00113	00112	00110	00109	00108	00107	3	1
44	00106	00105	00104	00103	00102	00101	00099	00098	00097	00096	00095	00094	4	1
45	0.00093	00092	00091	00090	00089	00088	00087	00086	00085	00084	00083	00082	s	
46	00081	00080	00079	00078	00077	00076	00075	00075	00074	00073	00072	00071	1	0
47	00070	00069	00068	00067	00066	00066	00065	00064	00063	00062	00061	00060	2	0
48	00060	00059	00058	00057	00056	00056	00055	00054	00053	00052	00052	00051	3	1
49	00050	00049	00049	00048	00047	00046	00046	00045	00044	00044	00043	00042	4	1
50	0.00041	00041	00040	00039	00039	00038	00037	00037	00036	00035	00035	00034	s	
51	00034	00033	00032	00032	00031	00031	00030	00029	00029	00028	00028	00027	1	0
52	00027	00026	00025	00025	00024	00024	00023	00023	00022	00022	00021	00021	2	0
53	00020	00020	00019	00019	00018	00018	00017	00017	00016	00016	00016	00015	3	0
54	00015	00015	00014	00014	00013	00013	00013	00012	00012	00011	00011	00011	4	1
55	0.00010	00010	00010	00009	00009	00009	00008	00008	00008	00008	00007	00007	s	
56	00007	00006	00006	00006	00006	00005	00005	00005	00005	00004	00004	00004	1	0
57	00004	00004	00003	00003	00003	00003	00003	00002	00002	00002	00002	00002	2	0
58	00002	00002	00001	00001	00001	00001	00001	00001	00001	00001	00001	00001	3	0
59	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	4	1

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

0 Hour.

M	0ˢ	5ˢ	10ˢ	15ˢ	20ˢ	25ˢ	30ˢ	35ˢ	40ˢ	45ˢ	50ˢ	55ˢ	Pro. pts.	
0	2.00000	86167	16270	33879	46373	56064	63982	70676	76476	81591	86167	90306		
1	$\frac{4}{3}$ 94085	97561	00779	03776	06578	09211	11694	14042	16269	18388	20408	22339		
2	3.24187	25960	27663	29302	30882	32406	33878	35302	36681	38017	39313	40572		
3	41796	42986	44141	45272	46371	47443	48490	49512	50510	51486	52440	53374		
4	54289	55181	56061	56921	57764	58592	59403	60200	60982	61751	62506	63249		
5	3.63978	64696	65402	66097	66781	67454	68117	68770	69413	70047	70672	71288		
6	71895	72494	73085	73667	74242	74810	75370	75923	76469	77009	77542	78068		
7	78588	79102	79609	80111	80607	81098	81583	82063	82537	83007	83471	83930		
8	84385	84835	85280	85721	86157	86589	87017	87440	87860	88275	88686	89091		
9	89498	89898	90294	90687	91076	91462	91845	92224	92600	92972	93341	93708		
10	3.94071	94431	94788	95143	95494	95843	96188	96532	96872	97216	97545	97877	s	
11	¾ 98207	98535	98860	99183	99503	99821	00136	00450	00761	01070	01376	01681	1	60
12	4.01983	02283	02581	02878	03172	03464	03754	04043	04329	04613	04896	05177	2	120
13	05476	05733	06008	06282	06554	06824	07093	07360	07625	07889	08151	08412	3	180
14	08671	08928	09184	09438	09691	09943	10193	10441	10688	10934	11178	11421	4	240
15	4.11663	11903	12142	12380	12616	12851	13085	13317	13549	13779	14007	14235	s	
16	14461	14687	14911	15134	15355	15576	15796	16014	16231	16448	16663	16877	1	42
17	17090	17302	17513	17723	17932	18139	18346	18552	18757	18962	19164	19366	2	84
18	19567	19768	19967	20165	20363	20559	20755	20950	21143	21336	21529	21720	3	126
19	21910	22100	22289	22477	22664	22850	23036	23221	23404	23588	23770	23952	4	168
20	4.24133	24313	24492	24671	24849	25026	25202	25378	25553	25727	25901	26074	s	
21	26246	26417	26588	26758	26928	27097	27265	27432	27599	27765	27931	28096	1	32
22	28260	28424	28587	28750	28911	29073	29233	29393	29553	29712	29870	30028	2	65
23	30185	30341	30497	30653	30807	30962	31115	31269	31421	31573	31725	31876	3	97
24	32026	32176	32326	32475	32623	32771	32919	33066	33212	33358	33503	33648	4	130
25	4.33793	33937	34080	34223	34365	34508	34649	34790	34931	35071	35211	35350	s	
26	35489	35627	35765	35903	36040	36176	36313	36448	36584	36719	36853	36987	1	26
27	37121	37254	37387	37519	37651	37783	37914	38045	38175	38305	38434	38564	2	53
28	38692	38821	38949	39077	39204	39331	39457	39583	39709	39835	39960	40084	3	79
29	40209	40333	40456	40579	40702	40825	40947	41069	41190	41311	41432	41553	4	106
30	4.41673	41793	41912	42031	42150	42268	42386	42504	42622	42739	42856	42972	s	
31	43088	43204	43320	43435	43550	43665	43779	43893	44007	44120	44233	44346	1	22
32	44459	44571	44683	44794	44906	45017	45127	45238	45348	45458	45568	45677	2	44
33	45786	45895	46003	46111	46219	46327	46434	46542	46648	46755	46861	46967	3	67
34	47073	47179	47284	47389	47494	47598	47702	47807	47910	48014	48117	48220	4	89
35	4.48323	48425	48527	48629	48731	48833	48934	49035	49136	49236	49336	49436	s	
36	49536	49636	49735	49834	49933	50032	50130	50229	50326	50424	50522	50619	1	19
37	50716	50813	50910	51006	51102	51198	51294	51389	51485	51580	51675	51769	2	38
38	51864	51958	52052	52146	52240	52333	52426	52519	52612	52705	52797	52889	3	57
39	52981	53073	53165	53256	53347	53438	53529	53620	53710	53801	53891	53980	4	77
40	4.54070	54160	54249	54338	54427	54515	54604	54692	54780	54868	54956	55044	s	
41	55131	55219	55306	55392	55479	55566	55652	55738	55824	55910	55996	56081	1	17
42	56166	56251	56336	56421	56506	56590	56674	56759	56842	56926	57010	57093	2	34
43	57176	57260	57343	57425	57508	57590	57673	57755	57837	57918	58000	58082	3	51
44	58163	58244	58325	58406	58487	58567	58648	58728	58808	58888	58967	59047	4	68
45	4.59127	59206	59285	59364	59443	59522	59600	59679	59757	59835	59913	59991	s	
46	60069	60146	60223	60301	60378	60455	60532	60608	60685	60761	60838	60914	1	15
47	60990	61066	61141	61217	61292	61368	61443	61518	61593	61667	61742	61817	2	30
48	61891	61965	62039	62113	62187	62261	62334	62408	62481	62554	62627	62700	3	45
49	62773	62846	62918	62991	63063	63135	63207	63279	63351	63422	63494	63565	4	60
50	4.63637	63708	63779	63850	63921	63991	64062	64132	64203	64273	64343	64413	s	
51	64483	64553	64622	64692	64761	64830	64899	64968	65037	65106	65175	65243	1	14
52	65312	65380	65448	65517	65584	65652	65720	65788	65855	65923	65990	66057	2	27
53	66125	66192	66258	66325	66392	66458	66525	66591	66658	66724	66790	66856	3	41
54	66922	66987	67053	67118	67184	67249	67314	67379	67444	67509	67574	67639	4	54
55	4.67703	67768	67832	67897	67961	68025	68089	68153	68216	68280	68344	68407	s	
56	68471	68534	68597	68660	68723	68786	68849	68912	68974	69037	69099	69161	1	12
57	69224	69286	69348	69410	69472	69533	69595	69657	69718	69779	69841	69902	2	25
58	69963	70024	70085	70146	70206	70267	70328	70388	70449	70509	70569	70629	3	37
59	70689	70749	70809	70869	70928	70988	71047	71107	71166	71225	71285	71344	4	50

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

1 Hour.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	4.71403	71462	71520	71579	71638	71696	71755	71813	71871	71930	71988	72046	s	
1	72104	72162	72219	72277	72335	72392	72150	72507	72564	72622	72679	72736	1	11
2	72793	72850	72907	72963	73020	73077	73133	73190	73246	73302	73358	73414	2	22
3	73470	73526	73582	73638	73694	73749	73805	73861	73916	73971	74027	74082	3	34
4	74137	74192	74247	74302	74356	74411	74466	74521	74575	74629	74684	74738	4	45
5	4.74792	74846	74900	74955	75008	75062	75116	75170	75223	75277	75330	75384	s	
6	75437	75491	75544	75597	75650	75703	75756	75809	75861	75914	75967	76019	1	10
7	76072	76124	76177	76229	76281	76333	76385	76437	76489	76541	76593	76645	2	21
8	76697	76748	76800	76851	76903	76954	77005	77057	77108	77159	77210	77261	3	31
9	77312	77362	77413	77464	77514	77565	77616	77666	77716	77767	77817	77867	4	42
10	4.77917	77967	78017	78067	78117	78167	78217	78266	78316	78365	78415	78464	s	
11	78514	78563	78612	78661	78710	78760	78809	78858	78906	78955	79004	79053	1	10
12	79101	79150	79198	79247	79295	79344	79392	79440	79488	79536	79584	79632	2	19
13	79680	79728	79776	79824	79871	79919	79966	80014	80061	80109	80156	80203	3	29
14	80251	80298	80345	80392	80439	80486	80533	80580	80626	80673	80720	80766	4	38
15	4.80813	80859	80906	80952	80999	81045	81091	81137	81183	81229	81275	81321	s	
16	81367	81413	81459	81505	81550	81596	81641	81687	81732	81778	81823	81868	1	9
17	81914	81959	82004	82049	82094	82139	82184	82229	82274	82319	82363	82408	2	18
18	82453	82497	82542	82586	82630	82675	82719	82763	82808	82852	82896	82940	3	27
19	82984	83028	83072	83116	83159	83203	83247	83291	83334	83378	83421	83465	4	36
20	4.83508	83552	83595	83638	83681	83725	83768	83811	83854	83897	83940	83983	s	
21	84025	84068	84111	84154	84196	84239	84281	84324	84366	84409	84451	84493	1	8
22	84536	84578	84620	84662	84704	84746	84788	84830	84872	84914	84956	84997	2	17
23	85039	85081	85122	85164	85205	85247	85288	85330	85371	85412	85454	85495	3	25
24	85536	85577	85618	85659	85700	85741	85782	85823	85864	85904	85945	85986	4	34
25	4.86026	86067	86108	86148	86188	86229	86269	86310	86350	86390	86430	86470	s	
26	86511	86551	86591	86631	86671	86710	86750	86790	86830	86870	86909	86949	1	8
27	86989	87028	87068	87107	87147	87186	87225	87265	87304	87343	87382	87421	2	16
28	87461	87500	87539	87578	87617	87656	87694	87733	87772	87811	87849	87888	3	24
29	87927	87965	88004	88042	88081	88119	88158	88196	88234	88272	88311	88349	4	32
30	4.88387	88425	88463	88501	88539	88577	88615	88653	88691	88729	88766	88804	s	
31	88842	88879	88917	88954	88992	89030	89067	89104	89142	89179	89216	89254	1	7
32	89291	89328	89365	89102	89439	89476	89513	89550	89587	89624	89661	89698	2	15
33	89735	89771	89808	89845	89881	89918	89954	89991	90027	90064	90100	90137	3	22
34	90173	90209	90246	90282	90318	90354	90390	90426	90462	90498	90534	90570	4	30
35	4.90606	90642	90678	90714	90749	90785	90821	90857	90892	90928	90963	90999	s	
36	91034	91070	91105	91141	91176	91211	91247	91282	91317	91352	91387	91422	1	7
37	91457	91493	91527	91563	91597	91632	91667	91702	91737	91772	91806	91841	2	14
38	91876	91910	91945	91980	92014	92049	92083	92117	92152	92186	92221	92255	3	21
39	92289	92323	92358	92392	92426	92460	92494	92528	92562	92596	92630	92664	4	28
40	4.92698	92732	92765	92799	92833	92867	92900	92934	92968	93001	93035	93068	s	
41	93102	93135	93169	93202	93236	93269	93302	93336	93369	93402	93435	93468	1	7
42	93501	93535	93568	93601	93634	93667	93700	93732	93765	93798	93831	93864	2	13
43	93897	93929	93962	93995	94027	94060	94092	94125	94157	94190	94222	94255	3	20
44	94287	94320	94352	94384	94416	94449	94481	94513	94545	94577	94609	94642	4	26
45	4.94674	94706	94738	94770	94801	94833	94865	94897	94929	94961	94992	95024	s	
46	95056	95087	95119	95151	95182	95214	95245	95277	95308	95340	95371	95402	1	6
47	95434	95465	95496	95528	95559	95590	95621	95652	95683	95715	95746	95777	2	12
48	95808	95839	95870	95901	95931	95962	95993	96024	96055	96086	96116	96147	3	19
49	96178	96208	96239	96269	96300	96331	96361	96392	96422	96452	96483	96513	4	25
50	4.96544	96574	96604	96634	96665	96695	96725	96755	96785	96816	96846	96876	s	
51	96906	96936	96966	96996	97025	97055	97085	97115	97145	97175	97204	97234	1	6
52	97264	97294	97323	97353	97383	97412	97442	97471	97501	97530	97560	97589	2	12
53	97618	97648	97677	97707	97736	97765	97794	97824	97853	97882	97911	97940	3	18
54	97969	97998	98027	98056	98085	98114	98143	98172	98201	98230	98259	98288	4	24
55	4.98316	98345	98374	98403	98431	98160	98489	98517	98546	98575	98603	98632	s	
56	98660	98689	98717	98746	98774	98802	98831	98859	98887	98916	98941	98972	1	6
57	99000	99028	99057	99085	99113	99141	99169	99197	99225	99253	99281	99309	2	12
58	99337	99365	99393	99421	99448	99476	99504	99532	99559	99587	99615	99643	3	17
59	99670	99698	99725	99753	99780	99808	99835	99863	99890	99918	99945	99973	4	23

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

2 Hours.

M	0ˢ	5ˢ	10ˢ	15ˢ	20ˢ	25ˢ	30ˢ	35ˢ	40ˢ	45ˢ	50ˢ	55ˢ	Pro. pts.	
0	5.00000	00027	00055	00082	00109	00137	00164	00191	00218	00245	00272	00300	s	
1	00327	00354	00381	00408	00435	00462	00489	00516	00542	00569	00596	00623	1	5
2	00650	00677	00703	00730	00757	00784	00810	00837	00864	00890	00917	00943	2	10
3	00970	00997	01023	01050	01076	01103	01129	01155	01182	01208	01234	01261	3	16
4	01287	01313	01339	01366	01392	01418	01444	01470	01496	01523	01549	01575	4	21
5	5.01601	01627	01653	01679	01705	01731	01757	01782	01808	01834	01860	01886	s	
6	01912	01937	01963	01989	02014	02040	02066	02091	02117	02143	02168	02194	1	5
7	02219	02245	02270	02296	02321	02347	02372	02397	02423	02448	02473	02499	2	10
8	02524	02549	02574	02600	02625	02650	02675	02700	02725	02751	02776	02801	3	15
9	02826	02851	02876	02901	02926	02951	02976	03001	03025	03050	03075	03100	4	20
10	5.03125	03149	03174	03199	03224	03248	03273	03298	03322	03347	03372	03396	s	
11	03421	03445	03470	03494	03519	03543	03568	03592	03616	03641	03665	03690	1	5
12	03714	03738	03762	03787	03811	03835	03859	03884	03908	03932	03956	03980	2	10
13	04004	04028	04052	04077	04100	04125	04148	04172	04196	04220	04244	04268	3	14
14	04292	04316	04340	04363	04387	04411	04435	04459	04482	04506	04530	04553	4	19
15	5.04577	04601	04624	04648	04671	04695	04718	04742	04765	04789	04812	04836	s	
16	04859	04883	04906	04929	04953	04976	04999	05023	05046	05069	05092	05116	1	5
17	05139	05162	05185	05208	05231	05255	05278	05301	05324	05347	05370	05393	2	9
18	05416	05439	05462	05485	05508	05531	05553	05576	05599	05622	05645	05668	3	14
19	05690	05713	05736	05758	05781	05804	05827	05849	05872	05894	05917	05940	4	18
20	5.05962	05985	06007	06030	06052	06075	06097	06120	06142	06164	06187	06209	s	
21	06232	06254	06276	06299	06321	06343	06365	06388	06410	06432	06454	06476	1	4
22	06498	06521	06543	06565	06587	06609	06631	06653	06675	06697	06719	06741	2	9
23	06763	06785	06807	06829	06850	06872	06894	06916	06938	06960	06981	07003	3	13
24	07025	07047	07068	07090	07112	07133	07155	07176	07198	07220	07241	07263	4	18
25	5.07284	07306	07328	07349	07371	07392	07413	07435	07456	07478	07499	07520	s	
26	07542	07563	07584	07606	07627	07648	07670	07691	07712	07733	07754	07776	1	4
27	07797	07818	07839	07860	07881	07902	07923	07944	07965	07986	08007	08028	2	8
28	08049	08070	08091	08112	08133	08154	08175	08196	08216	08237	08258	08279	3	13
29	08300	08320	08341	08362	08383	08403	08424	08445	08465	08486	08507	08527	4	17
30	5.08548	08568	08589	08609	08630	08650	08671	08691	08712	08732	08753	08773	s	
31	08794	08814	08834	08855	08875	08895	08916	08936	08956	08977	08997	09017	1	4
32	09037	09057	09078	09098	09118	09138	09158	09178	09198	09219	09239	09259	2	8
33	09279	09299	09319	09339	09359	09379	09399	09419	09438	09458	09478	09498	3	12
34	09518	09538	09558	09577	09597	09617	09637	09657	09676	09696	0971	09735	4	16
35	5.09755	09775	09794	09814	09834	09853	09873	09893	09912	09932	09951	09971	s	
36	09990	10010	10029	10049	10068	10088	10107	10126	10146	10165	10184	10204	1	4
37	10223	10243	10262	10281	10300	10320	10339	10358	10377	10397	10416	10435	2	8
38	10454	10473	10492	10512	10531	10550	10569	10588	10607	10626	10645	10664	3	11
39	10683	10702	10721	10740	10759	10778	10797	10816	10834	10853	10872	10891	4	15
40	5.10910	10929	10947	10966	10985	11004	11022	11041	11060	11079	11097	11116	s	
41	11135	11153	11172	11190	11209	11228	11246	11265	11283	11302	11320	11339	1	4
42	11357	11376	11394	11413	11431	11450	11468	11487	11505	11523	11542	11560	2	7
43	11578	11597	11615	11633	11652	11670	11688	11706	11725	11743	11761	11779	3	11
44	11797	11815	11834	11852	11870	11888	11906	11924	11942	11960	11978	11996	4	14
45	5.12014	12032	12050	12068	12086	12104	12122	12140	12158	12176	12194	12212	s	
46	12229	12247	12265	12283	12301	12319	12336	12354	12372	12390	12407	12425	1	4
47	12443	12460	12478	12496	12513	12531	12549	12566	12584	12601	12619	12637	2	7
48	12654	12672	12689	12707	12724	12742	12759	12777	12794	12811	12829	12846	3	11
49	12864	12881	12898	12916	12933	12950	12968	12985	13002	13020	13037	13054	4	14
50	5.13071	13089	13106	13123	13140	13157	13175	13192	13209	13226	13243	13260	s	
51	13277	13294	13311	13228	13345	13363	13380	13397	13413	13431	13447	13464	1	3
52	13481	13498	13515	13532	13549	13566	13583	13600	13616	13633	13650	13667	2	7
53	13684	13700	13717	13734	13751	13767	13784	13801	13818	13834	13851	13868	3	10
54	13884	13901	13917	13934	13951	13967	13984	14009	14017	14034	14050	14067	4	14
55	5.14083	14100	14116	14133	14149	14165	14182	14198	14215	14231	14247	14264	s	
56	14280	14297	14313	14329	14345	14362	14378	14394	14411	14427	14443	14459	1	3
57	14476	14492	14508	14524	14540	14556	14573	14589	14605	14621	14637	14653	2	6
58	14669	14685	14701	14717	14733	14749	14765	14781	14797	14813	14829	14845	3	10
59	14861	14877	14893	14909	14925	14941	14957	14972	14988	15004	15020	15036	4	13

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

3 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	5.15051	15067	15083	15099	15115	15130	15146	15162	15177	15193	15209	15225	s	
1	15240	15256	15271	15287	15303	15318	15334	15350	15365	15381	15396	15412	1	3
2	15427	15443	15458	15474	15489	15505	15520	15536	15551	15566	15582	15597	2	6
3	15613	15628	15643	15659	15674	15689	15705	15720	15735	15751	15766	15781	3	10
4	15796	15812	15827	15842	15857	15873	15888	15903	15918	15933	15948	15964	4	13
5	5.15979	15994	16009	16024	16039	16054	16069	16084	16099	16114	16129	16144	s	
6	16159	16174	16189	16204	16219	16234	16249	16264	16279	16294	16309	16323	1	3
7	16338	16353	16368	16383	16398	16412	16427	16442	16457	16472	16486	16501	2	6
8	16516	16531	16545	16560	16575	16589	16604	16619	16633	16648	16662	16677	3	9
9	16692	16706	16721	16735	16750	16765	16779	16794	16808	16823	16837	16852	4	12
10	5.16866	16881	16895	16909	16924	16938	16953	16967	16982	16996	17010	17025	s	
11	17039	17053	17068	17082	17096	17111	17125	17139	17153	17168	17182	17196	1	3
12	17210	17225	17239	17253	17267	17281	17295	17310	17324	17338	17352	17366	2	6
13	17380	17394	17408	17423	17437	17451	17465	17479	17493	17507	17521	17535	3	8
14	17549	17563	17577	17591	17604	17618	17632	17646	17660	17674	17688	17702	4	11
15	5.17716	17729	17743	17757	17771	17785	17798	17812	17826	17840	17854	17867	s	
16	17881	17895	17908	17922	17936	17950	17963	17977	17990	18004	18018	18031	1	3
17	18045	18059	18072	18086	18099	18113	18126	18140	18154	18167	18181	18194	2	5
18	18208	18221	18235	18248	18261	18275	18288	18302	18315	18329	18342	18355	3	8
19	18369	18382	18395	18409	18422	18435	18449	18462	18475	18489	18502	18515	4	10
20	5.18528	18542	18555	18568	18581	18595	18608	18621	18634	18647	18660	18674	s	
21	18687	18700	18713	18726	18739	18752	18765	18778	18791	18805	18818	18831	1	3
22	18844	18857	18870	18883	18896	18909	18922	18935	18947	18960	18973	18986	2	5
23	18999	19012	19025	19038	19051	19064	19076	19089	19102	19115	19128	19141	3	8
24	19153	19166	19179	19192	19204	19217	19230	19243	19255	19268	19281	19293	4	10
25	5.19306	19319	19331	19344	19357	19369	19382	19395	19407	19420	19432	19445	s	
26	19457	19470	19483	19495	19508	19520	19533	19545	19558	19570	19583	19595	1	2
27	19607	19620	19632	19645	19657	19670	19682	19694	19707	19719	19732	19744	2	5
28	19756	19769	19781	19793	19805	19818	19830	19842	19855	19867	19879	19891	3	7
29	19904	19916	19928	19940	19952	19965	19977	19989	20001	20013	20025	20038	4	10
30	5.20050	20062	20074	20086	20098	20110	20122	20134	20146	20158	20170	20182	s	
31	20194	20206	20218	20230	20242	20254	20266	20278	20290	20302	20314	20326	1	2
32	20338	20350	20362	20374	20385	20397	20409	20421	20433	20445	20456	20468	2	5
33	20480	20492	20504	20515	20527	20539	20551	20562	20574	20586	20597	20609	3	7
34	20621	20633	20644	20656	20668	20679	20691	20702	20714	20726	20737	20749	4	10
35	5.20760	20772	20784	20795	20807	20818	20830	20841	20853	20864	20876	20887	s	
36	20899	20910	20922	20933	20945	20956	20967	20979	20990	21002	21013	21024	1	2
37	21036	21047	21059	21070	21081	21093	21104	21115	21126	21138	21149	21160	2	4
38	21172	21183	21194	21205	21217	21228	21239	21250	21261	21273	21284	21295	3	7
39	21306	21317	21328	21340	21351	21362	21373	21384	21395	21406	21417	21428	4	9
40	5.21439	21451	21462	21473	21484	21495	21506	21517	21528	21539	21550	21561	s	
41	21572	21583	21593	21694	21615	21626	21637	21648	21659	21670	21681	21692	1	2
42	21702	21713	21724	21735	21746	21757	21767	21778	21789	21800	21810	21821	2	4
43	21832	21843	21853	21864	21875	21886	21896	21907	21918	21928	21939	21950	3	7
44	21960	21971	21982	21992	22003	22014	22024	22034	22045	22056	22067	22077	4	9
45	5.22088	22098	22109	22119	22130	22140	22151	22161	22172	22182	22193	22203	s	
46	22214	22224	22235	22245	22255	22266	22276	22287	22297	22307	22318	22328	1	2
47	22338	22349	22359	22370	22380	22390	22400	22411	22421	22431	22442	22452	2	4
48	22462	22472	22483	22493	22503	22513	22524	22534	22544	22554	22564	22574	3	6
49	22585	22595	22605	22615	22625	22635	22645	22656	22666	22676	22686	22696	4	8
50	5.22706	22716	22726	22736	22746	22756	22766	22776	22786	22796	22806	22816	s	
51	22826	22836	22846	22856	22866	22876	22886	22896	22906	22915	22925	22935	1	2
52	22945	22955	22965	22975	22984	22994	23004	23014	23024	23034	23043	23053	2	4
53	23063	23073	23082	23092	23102	23112	23121	23131	23141	23151	23160	23170	3	6
54	23180	23189	23199	23209	23218	23228	23237	23247	23257	23266	23276	23286	4	8
55	5.23295	23305	23314	23324	23333	23343	23352	23362	23372	23381	23391	23400	s	
56	23410	23419	23429	23438	23447	23457	23466	23476	23485	23495	23504	23514	1	2
57	23523	23532	23542	23551	23560	23570	23579	23588	23598	23607	23616	23626	2	4
58	23635	23644	23654	23663	23672	23681	23691	23700	23709	23718	23728	23737	3	6
59	23746	23755	23765	23774	23783	23792	23801	23810	23820	23829	23838	23847	4	8

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

4 Hours.

M	0^{s}	5^{s}	10^{s}	15^{s}	20^{s}	25^{s}	30^{s}	35^{s}	40^{s}	45^{s}	50^{s}	55^{s}	Pro. pts.	
0	5.23856	23865	23874	23883	23892	23902	23911	23920	23929	23938	23947	23956	s	
1	23965	23974	23983	23992	24001	24010	24019	24028	24037	24046	24055	21064	1	2
2	24073	24082	24091	24099	24108	24117	24126	24135	24144	24153	24162	24171	2	4
3	24179	24188	24197	24206	24215	24224	24232	24241	24250	24259	24267	24276	3	5
4	24285	24294	24302	24311	24320	24329	24337	24346	24355	24363	24372	24381	4	7
5	5.24389	24398	24407	24415	24424	24433	24441	24150	24458	24467	21476	24484	s	
6	21493	24501	24510	24519	24527	24536	24544	24553	24561	24570	24578	24587	1	2
7	24595	21604	24612	21621	24629	21638	24646	24654	24663	24671	24680	24688	2	4
8	24696	24705	24713	24722	24730	24738	24747	24755	24763	24772	24780	24788	3	5
9	24797	24805	24813	24822	24830	21838	24846	21855	24863	24871	24879	21888	4	7
10	5.24896	21904	24912	24921	24929	24937	24945	24953	24961	24970	21978	21986	s	
11	24994	25002	25010	25018	25026	25035	25043	25051	25059	25067	25075	25083	1	2
12	25091	25099	25107	25115	25123	25131	25139	25147	25155	25163	25171	25179	2	3
13	25187	25195	25203	25211	25219	25227	25235	25243	25251	25259	25266	25271	3	5
14	25282	25290	25298	25306	25314	25321	25329	25337	25345	25353	25360	25368	4	6
15	5.25376	25384	25392	25399	25407	25415	25423	25430	25438	25446	25454	25461	s	
16	25469	25477	25484	25492	25500	25507	25515	25523	25530	25538	25546	25553	1	2
17	25561	25569	25576	25584	25591	25599	25607	25614	25622	25629	25637	25644	2	3
18	25652	25659	25667	25674	25682	25689	25697	25704	25712	25719	25727	25734	3	5
19	25742	25749	25757	25764	25771	25779	25786	25794	25801	25808	25816	25823	4	6
20	5.25831	25838	25845	25853	25860	25867	25875	25882	25889	25897	25904	25911	s	
21	25918	25926	25933	25940	25947	25955	25962	25969	25976	25984	25991	25998	1	1
22	26005	26013	26020	26027	26034	26041	26048	26056	26063	26070	26077	26084	2	3
23	26091	26098	26105	26113	26120	26127	26134	26141	26148	26155	26162	26169	3	4
24	26176	26183	26190	26197	26204	26211	26218	26225	26232	26239	26246	26253	4	6
25	5.26260	26267	26274	26281	26288	26295	26301	26308	26315	26322	26329	26336	s	
26	26343	26350	26356	26363	26370	26377	26384	26391	26397	26404	26411	26418	1	1
27	26425	26432	26438	26445	26452	26459	26465	26472	26479	26486	26492	26499	2	3
28	26506	26512	26519	26526	26532	26539	26546	26552	26559	26566	26572	26579	3	4
29	26586	26592	26599	26605	26612	26619	26625	26632	26638	26645	26651	26658	4	6
30	5.26665	26671	26678	26684	26691	26697	26704	26710	26717	26723	26730	26736	s	
31	26743	26749	26755	26762	26768	26775	26781	26788	26794	26800	26807	26813	1	1
32	26820	26826	26832	26839	26845	26851	26858	26864	26870	26877	26883	26889	2	2
33	26896	26902	26908	26915	26921	26927	26933	26940	26946	26952	26958	26965	3	4
34	26971	26977	26983	26989	26996	27002	27008	27014	27020	27027	27033	27039	4	5
35	5.27045	27051	27057	27063	27069	27076	27082	27088	27094	27100	27106	27112	s	
36	27118	27124	27130	27136	27142	27148	27154	27160	27166	27172	27178	27184	1	1
37	27190	27196	27202	27208	27214	27220	27226	27232	27238	27244	27250	27256	2	2
38	27262	27268	27274	27279	27285	27291	27297	27303	27309	27315	27320	27326	3	4
39	27332	27338	27344	27350	27355	27361	27367	27373	27379	27384	27390	27396	4	5
40	5.27402	27407	27413	27419	27425	27430	27436	27442	27447	27453	27459	27461	s	
41	27470	27476	27481	27487	27493	27498	27504	27510	27515	27521	27526	27532	1	1
42	27538	27543	27549	27554	27560	27566	27571	27577	27582	27588	27593	27599	2	2
43	27604	27610	27615	27621	27626	27632	27637	27643	27648	27651	27659	27665	3	3
44	27670	27675	27681	27686	27692	27697	27703	27708	27713	27719	27724	27729	4	4
45	5.27735	27740	27746	27751	27756	27762	27767	27772	27777	27783	27788	27793	s	
46	27799	27804	27809	27815	27820	27825	27830	27836	27841	27846	27851	27856	1	1
47	27862	27867	27872	27877	27882	27888	27893	27898	27903	27908	27913	27919	2	2
48	27924	27929	27934	27939	27944	27949	27954	27959	27964	27970	27975	27980	3	3
49	27985	27990	27995	28000	28005	28010	28015	28020	28025	28030	28035	28040	4	4
50	5.28045	28050	28055	28060	28065	28070	28075	28080	28085	28090	28094	28099	s	
51	28101	28109	28114	28119	28124	28129	28134	28138	28143	28148	28153	28158	1	1
52	28163	28168	28172	28177	28182	28187	28191	28196	28201	28206	28211	28215	2	2
53	28220	28225	28230	28234	28239	28244	28249	28253	28258	28263	28267	28272	3	3
54	28277	28281	28286	28291	28295	28300	28305	28309	28314	28319	28323	28328	4	4
55	5.28332	28337	28342	28346	28351	28355	28360	28364	28369	28374	28378	28383	s	
56	28387	28392	28396	28401	28405	28410	28414	28419	28123	28428	28432	28437	1	1
57	28441	28446	28450	28454	28459	28463	28468	28472	28176	28181	28485	28190	2	2
58	28494	28498	28503	28507	28512	28516	28520	28525	28529	28533	28538	28542	3	2
59	28546	28551	28555	28559	28563	28568	28572	28576	28580	28585	28589	28593	4	3

TABLE XXVIII.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

MIDDLE TIME.

5 Hours.

M	0ˢ	5ˢ	10ˢ	15ˢ	20ˢ	25ˢ	30ˢ	35ˢ	40ˢ	45ˢ	50ˢ	55ˢ	Pro. pts.	
0	5.28597	28602	28606	28610	28614	28619	28623	28627	28631	28635	28639	28644	s	
1	28648	28652	28656	28660	28664	28668	28673	28677	28681	28685	28689	28693	1	1
2	28697	28701	28705	28709	28713	28718	28722	28726	28730	28734	28738	28742	2	2
3	28746	28750	28754	28758	28762	28766	28770	28774	28778	28782	28786	28790	3	2
4	28793	28797	28801	28805	28809	28813	28817	28821	28825	28829	28832	28836	4	3
5	5.28840	28844	28848	28852	28856	28860	28863	28867	28871	28875	28879	28882	s	
6	28886	28890	28894	28898	28901	28905	28909	28913	28916	28920	28924	28928	1	1
7	28931	28935	28939	28942	28946	28950	28953	28957	28961	28964	28968	28972	2	2
8	28975	28979	28983	28986	28990	28994	28997	29001	29004	29008	29012	29015	3	2
9	29019	29022	29026	29029	29033	29037	29040	29044	29047	29051	29054	29058	4	3
10	5.29061	29065	29068	29072	29075	29079	29082	29086	29089	29092	29096	29099	s	
11	29103	29106	29110	29113	29116	29120	29123	29127	29130	29133	29137	29140	1	1
12	29143	29147	29150	29154	29157	29160	29163	29167	29170	29173	29177	29180	2	1
13	29183	29187	29190	29193	29196	29200	29203	29206	29209	29213	29216	29219	3	2
14	29222	29226	29229	29232	29235	29238	29241	29245	29248	29251	29254	29257	4	2
15	5.29260	29264	29267	29270	29273	29276	29279	29282	29285	29288	29292	29295	s	
16	29298	29301	29304	29307	29310	29313	29316	29319	29322	29325	29328	29331	1	1
17	29334	29337	29340	29343	29346	29349	29352	29355	29358	29361	29364	29367	2	1
18	29370	29373	29375	29378	29381	29384	29387	29390	29393	29396	29399	29401	3	2
19	29404	29407	29410	29413	29416	29419	29421	29424	29427	29430	29433	29435	4	2
20	5.29438	29441	29444	29447	29449	29452	29455	29458	29460	29463	29466	29468	s	
21	29471	29474	29477	29479	29482	29485	29487	29490	29493	29495	29498	29501	1	1
22	29503	29506	29509	29511	29514	29516	29519	29522	29524	29527	29529	29532	2	1
23	29535	29537	29540	29542	29545	29547	29550	29552	29555	29558	29560	29563	3	2
24	29565	29568	29570	29573	29575	29577	29580	29582	29585	29587	29590	29592	4	2
25	5.29595	29597	29599	29602	29604	29607	29609	29611	29614	29616	29619	29621	s	
26	29623	29626	29628	29630	29633	29635	29637	29640	29642	29644	29647	29649	1	0
27	29651	29654	29656	29658	29660	29663	29665	29667	29669	29672	29674	29676	2	1
28	29678	29681	29683	29685	29687	29689	29691	29694	29696	29698	29700	29702	3	1
29	29704	29707	29709	29711	29713	29715	29717	29719	29721	29724	29726	29728	4	2
30	5.29730	29732	29734	29736	29738	29740	29742	29744	29746	29748	29750	29752	s	
31	29754	29756	29758	29760	29762	29764	29766	29768	29770	29772	29774	29776	1	0
32	29778	29780	29782	29784	29786	29788	29790	29791	29793	29795	29797	29799	2	1
33	29801	29803	29805	29807	29808	29810	29812	29814	29816	29818	29819	29821	3	1
34	29823	29825	29827	29828	29830	29832	29834	29835	29837	29839	29841	29842	4	2
35	5.29844	29846	29848	29849	29851	29853	29854	29856	29858	29859	29861	29863	s	
36	29864	29866	29868	29869	29871	29873	29874	29876	29878	29879	29881	29882	1	0
37	29884	29886	29887	29889	29890	29892	29893	29895	29896	29898	29900	29901	2	1
38	29903	29904	29906	29907	29909	29910	29912	29913	29915	29916	29918	29919	3	1
39	29920	29922	29923	29925	29926	29928	29929	29930	29932	29933	29935	29936	4	2
40	5.29937	29939	29940	29942	29943	29944	29946	29947	29948	29950	29951	29952	s	
41	29954	29955	29956	29958	29959	29960	29961	29963	29964	29965	29966	29968	1	0
42	29969	29970	29971	29973	29974	29975	29976	29978	29979	29980	29981	29982	2	0
43	29983	29985	29986	29987	29988	29989	29990	29992	29993	29994	29995	29996	3	1
44	29997	29998	29999	30000	30001	30003	30004	30005	30006	30007	30008	30009	4	1
45	5.30010	30011	30012	30013	30014	30015	30016	30017	30018	30019	30020	30021	s	
46	30022	30023	30024	30025	30026	30027	30028	30029	30029	30030	30031	30032	1	0
47	30033	30034	30035	30036	30037	30038	30038	30039	30040	30041	30042	30043	2	0
48	30043	30044	30045	30046	30047	30048	30048	30049	30050	30051	30051	30052	3	1
49	30053	30054	30054	30055	30056	30057	30057	30058	30059	30060	30060	30061	4	1
50	5.30062	30062	30063	30064	30064	30065	30066	30066	30067	30068	30068	30069	s	
51	30070	30070	30071	30071	30072	30073	30073	30074	30074	30075	30075	30076	1	0
52	30077	30077	30078	30078	30079	30079	30080	30080	30081	30081	30082	30082	2	0
53	30083	30083	30084	30084	30085	30085	30086	30086	30086	30087	30087	30088	3	0
54	30088	30089	30089	30089	30090	30090	30090	30090	30091	30091	30092	30092	4	1
55	5.30093	30093	30093	30094	30094	30094	30095	30095	30095	30096	30096	30096	s	
56	30096	30097	30097	30097	30097	30098	30098	30098	30098	30099	30099	30099	1	0
57	30099	30100	30100	30100	30100	30100	30100	30101	30101	30101	30101	30101	2	0
58	30101	30102	30102	30102	30102	30102	30102	30102	30102	30102	30102	30102	3	0
59	30103	30103	30103	30103	30103	30103	30103	30103	30103	30103	30103	30103	4	1

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

0 Hour.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	9.				02436	21818	37654	51044	62642	72873	82024	90303		
1	$\frac{9}{0}$.97860	04813	11250	17242	22848	28114	33079	37775	42230	46468	50509	54370		
2	0.58066	61612	65019	68297	71455	74503	77448	80296	83054	85726	88319	90837		
3	$\frac{0}{1}$.93284	95664	97980	00236	02435	04580	06673	08717	10714	12666	14575	16443		
4	1.18271	20062	21817	23537	25224	26878	28502	30095	31660	33198	34708	36193		
5	1.37653	39088	40501	41890	43258	44605	45931	47237	48524	49792	51041	52273		
6	53488	54686	55868	57034	58184	59320	60440	61547	62639	63718	64784	65837		
7	66877	67905	68920	69924	70917	71898	72869	73829	74778	75717	76646	77565		
8	78474	79374	80265	81147	82019	82884	83739	84587	85426	86257	87080	87896		
9	88703	89504	90297	91083	91862	92634	93399	94157	94909	95655	96394	97127		
10	$\frac{1}{2}$.97854	98574	99289	99998	00701	01399	02091	02777	03458	04134	04805	05470	s	
11	2.06131	06786	07437	08082	08723	09359	09991	10618	11240	11859	12472	13082	1	119
12	13687	14288	14885	15477	16066	16651	17232	17809	18382	18951	19517	20079	2	238
13	20638	21192	21744	22292	22836	23377	23915	24449	24980	25508	26033	26554	3	368
14	27073	27588	28100	28609	29116	29619	30120	30617	31112	31604	32093	32579	4	476
15	2.33063	33544	34023	34498	34972	35442	35910	36376	36839	37299	37758	38213	s	
16	38667	39118	39567	40013	40457	40899	41339	41776	42211	42644	43075	43504	1	84
17	43930	44355	44777	45198	45616	46033	46447	46859	47270	47678	48085	48490	2	168
18	48893	49294	49693	50090	50486	50879	51271	51661	52050	52436	52821	53205	3	252
19	53586	53966	54344	54721	55096	55469	55841	56211	56580	56947	57313	57676	4	336
20	2.58039	58400	58759	59117	59474	59829	60182	60534	60885	61234	61582	61929	s	
21	62274	62618	62960	63302	63641	63979	64316	64652	64987	65320	65652	65982	1	65
22	66312	66640	66967	67292	67617	67940	68262	68583	68903	69221	69538	69855	2	130
23	70170	70483	70796	71108	71418	71728	72036	72343	72649	72954	73258	73561	3	195
24	73863	74164	74464	74762	75060	75357	75652	75947	76241	76533	76825	77116	4	260
25	2.77405	77694	77982	78269	78555	78840	79124	79407	79689	79970	80251	80530	s	
26	80809	81086	81363	81639	81914	82188	82461	82734	83005	83276	83546	83815	1	53
27	84083	84350	84617	84883	85148	85412	85675	85937	86199	86460	86720	86979	2	106
28	87238	87496	87753	88009	88265	88519	88773	89027	89279	89531	89782	90032	3	159
29	90282	90531	90779	91027	91273	91520	91765	92010	92254	92497	92739	92981	4	212
30	2.93223	93463	93703	93942	94181	94419	94656	94893	95129	95364	95599	95833	s	
31	96067	96299	96532	96763	96994	97224	97454	97683	97912	98140	98367	98594	1	45
32	$\frac{2}{3}$.98820	99045	99270	99495	99719	99942	00164	00386	00608	00829	01049	01269	2	90
33	3.01488	01707	01925	02143	02360	02576	02792	03008	03222	03437	03651	03864	3	134
34	04077	04289	04501	04712	04922	05133	05342	05551	05760	05968	06176	06383	4	178
35	3.06590	06796	07001	07207	07411	07616	07819	08023	08225	08428	08629	08831	s	
36	09032	09232	09432	09632	09831	10029	10227	10425	10622	10819	11015	11211	1	39
37	11406	11601	11796	11990	12184	12377	12570	12762	12954	13146	13337	13527	2	77
38	13718	13908	14097	14286	14475	14663	14850	15038	15225	15411	15597	15783	3	116
39	15969	16154	16338	16522	16706	16889	17072	17255	17437	17619	17800	17982	4	154
40	3.18162	18343	18522	18702	18881	19060	19238	19417	19594	19771	19949	20125	s	
41	20301	20477	20653	20828	21003	21177	21351	21525	21699	21872	22044	22217	1	34
42	22389	22560	22732	22903	23073	23244	23414	23583	23753	23922	24090	24259	2	68
43	24427	24594	24762	24929	25095	25262	25428	25594	25759	25924	26089	26253	3	102
44	26418	26581	26745	26908	27071	27234	27396	27558	27720	27881	28042	28203	4	137
45	3.28363	28524	28683	28843	29002	29161	29320	29478	29637	29794	29952	30109	s	
46	30266	30423	30579	30735	30891	31047	31202	31357	31512	31666	31820	31974	1	31
47	32128	32281	32434	32587	32739	32892	33044	33195	33347	33498	33649	33800	2	62
48	33950	34100	34250	34400	34549	34698	34847	34995	35144	35292	35439	35587	3	92
49	35734	35881	36028	36175	36321	36467	36613	36758	36903	37048	37193	37338	4	122
50	3.37482	37626	37770	37914	38057	38200	38343	38486	38628	38770	38912	39054	s	
51	39195	39336	39477	39618	39759	39899	40039	40179	40319	40458	40597	40736	1	27
52	40875	41013	41152	41290	41427	41565	41702	41839	41976	42113	42250	42386	2	55
53	42522	42658	42794	42929	43064	43199	43334	43469	43603	43737	43871	44005	3	82
54	44138	44272	44405	44537	44670	44803	44935	45067	45199	45331	45462	45593	4	110
55	3.45724	45855	45986	46116	46247	46377	46507	46636	46766	46895	47024	47153	s	
56	47282	47410	47539	47667	47795	47923	48050	48177	48305	48432	48558	48685	1	25
57	48811	48938	49064	49190	49315	49441	49566	49691	49816	49941	50066	50190	2	50
58	50314	50438	50562	50686	50809	50933	51056	51179	51301	51424	51547	51669	3	75
59	51791	51913	52035	52156	52278	52399	52520	52641	52761	52882	53002	53122	4	100

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

1 Hour.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	3.53243	53362	53482	53602	53721	53840	53959	54078	54197	54315	54434	54552	s	
1	54670	54788	54905	55023	55140	55258	55375	55492	55608	55725	55841	55958	1	23
2	56074	56190	56306	56421	56537	56652	56767	56882	56997	57112	57226	57341	2	46
3	57455	57569	57683	57797	57910	58024	58137	58250	58363	58476	58589	58702	3	70
4	58814	58926	59038	59150	59262	59374	59486	59597	59708	59819	59930	60041	4	93
5	3.60152	60262	60373	60483	60593	60703	60813	60923	61032	61143	61251	61360	s	
6	61469	61578	61686	61795	61903	62012	62120	62228	62336	62443	62551	62659	1	21
7	62766	62873	62980	63087	63194	63301	63407	63513	63620	63726	63832	63938	2	42
8	64013	64149	64254	64360	64465	64570	64675	64780	64885	64989	65094	65198	3	63
9	65302	65406	65510	65614	65717	65821	65924	66028	66131	66234	66337	66440	4	85
10	3.66542	66645	66747	66849	66952	67054	67156	67257	67359	67461	67562	67663	s	
11	67765	67866	67967	68067	68168	68269	68369	68469	68570	68670	68770	68870	1	20
12	68969	69069	69169	69268	69367	69467	69566	69665	69763	69862	69961	70059	2	40
13	70158	70256	70354	70452	70550	70648	70745	70843	70940	71038	71135	71232	3	60
14	71329	71426	71523	71620	71716	71813	71909	72005	72101	72197	72294	72389	4	80
15	3.72485	72580	72676	72771	72867	72962	73057	73152	73247	73341	73436	73530	s	
16	73625	73719	73813	73907	74001	74095	74189	74283	74376	74470	74563	74657	1	18
17	74750	74843	74936	75029	75121	75214	75307	75399	75491	75584	75676	75768	2	37
18	75860	75952	76043	76135	76227	76318	76409	76501	76592	76683	76774	76865	3	55
19	76955	77046	77137	77227	77318	77408	77498	77588	77678	77768	77858	77947	4	74
20	3.78037	78127	78216	78305	78395	78484	78573	78662	78750	78839	78928	79016	s	
21	79105	79193	79282	79370	79458	79546	79634	79722	79809	79897	79985	80072	1	17
22	80159	80247	80334	80421	80508	80595	80682	80768	80855	80942	81028	81115	2	35
23	81201	81287	81373	81459	81545	81631	81717	81802	81888	81974	82059	82144	3	52
24	82230	82315	82400	82485	82570	82655	82739	82824	82908	82993	83077	83162	4	70
25	3.83246	83330	83414	83498	83582	83666	83749	83833	83917	84000	84083	84167	s	
26	84250	84333	84416	84499	84582	84665	84748	84830	84913	84995	85078	85160	1	16
27	85242	85324	85406	85488	85570	85652	85734	85816	85897	85979	86060	86141	2	33
28	86223	86304	86385	86466	86547	86628	86709	86790	86870	86951	87031	87112	3	49
29	87192	87272	87352	87433	87513	87593	87672	87752	87832	87912	87991	88071	4	65
30	3.88150	88229	88309	88388	88467	88546	88625	88704	88783	88862	88940	89019	s	
31	89097	89176	89254	89333	89411	89489	89567	89645	89723	89801	89879	89956	1	15
32	90034	90112	90189	90267	90344	90421	90498	90576	90653	90730	90807	90884	2	31
33	90960	91037	91114	91190	91267	91343	91420	91496	91572	91648	91724	91800	3	46
34	91876	91952	92028	92104	92179	92255	92331	92406	92482	92557	92632	92707	4	62
35	3.92782	92858	92933	93007	93082	93157	93232	93306	93381	93456	93530	93605	s	
36	93679	93753	93827	93901	93975	94049	94123	94197	94271	94345	94418	94492	1	15
37	94566	94639	94712	94786	94859	94932	95005	95078	95152	95224	95297	95370	2	29
38	95443	95515	95588	95661	95733	95806	95878	95950	96023	96095	96167	96239	3	44
39	96311	96383	96455	96527	96599	96670	96742	96813	96885	96956	97028	97099	4	58
40	3.97170	97242	97313	97384	97455	97526	97597	97667	97738	97809	97880	97950	s	
41	98021	98091	98162	98232	98302	98372	98443	98513	98583	98653	98723	98793	1	14
42	98862	98932	99002	99072	99141	99211	99280	99350	99419	99488	99557	99627	2	28
43	3.99696	99765	99834	99903	99972	00040	00109	00178	00247	00315	00384	00452	3	42
44	4.00521	00589	00657	00726	00794	00862	00930	00998	01066	01134	01202	01270	4	56
45	4.01337	01405	01473	01540	01608	01675	01743	01810	01877	01945	02012	02079	s	
46	02146	02213	02280	02347	02414	02481	02547	02614	02681	02747	02814	02880	1	13
47	02947	03013	03080	03146	03212	03278	03344	03411	03477	03542	03608	03674	2	26
48	03740	03806	03871	03937	04003	04068	04134	04199	04265	04330	04395	04460	3	40
49	04526	04591	04656	04721	04786	04851	04916	04980	05045	05110	05175	05239	4	53
50	4.05304	05368	05433	05497	05561	05626	05690	05754	05818	05882	05946	06010	s	
51	06074	06138	66202	06266	06330	06393	06457	06521	06584	06648	06711	06775	1	13
52	06838	06901	06965	07028	07091	07154	07217	07280	07343	07406	07469	07532	2	25
53	07595	07657	07720	07783	07845	07908	07970	08033	08095	08157	08220	08282	3	38
54	08344	08406	08468	08530	08592	08654	08716	08778	08840	08902	08964	09025	4	50
55	4.09087	09148	09210	09272	09333	09394	09456	09517	09578	09640	09701	09762	s	
56	09823	09884	09945	10006	10067	10128	10188	10249	10310	10371	10431	10492	1	12
57	10552	10613	10673	10734	10794	10854	10915	10975	11035	11095	11155	11215	2	24
58	11275	11335	11395	11455	11515	11575	11634	11694	11754	11813	11873	11932	3	36
59	11992	12051	12111	12170	12229	12289	12348	12407	12466	12525	12584	12643	4	48

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

2 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts	
0	4.12702	12761	12820	12879	12938	12996	13055	13114	13172	13231	13289	13348	s	
1	13406	13465	13523	13581	13640	13698	13756	13814	13872	13931	13989	14047	1	11
2	14104	14162	14220	14278	14336	14394	14451	14508	14567	14625	14682	14739	2	23
3	14797	14854	14911	14969	15026	15083	15140	15198	15255	15312	15369	15426	3	34
4	15483	15540	15597	15653	15710	15767	15824	15880	15937	15994	16050	16107	4	46
5	4.16163	16220	16276	16332	16389	16445	16501	16557	16614	16670	16726	16782	s	
6	16838	16894	16950	17006	17062	17117	17173	17229	17285	17340	17396	17451	1	11
7	17507	17563	17618	17673	17729	17784	17840	17895	17950	18005	18060	18116	2	22
8	18171	18226	18281	18336	18391	18445	18500	18555	18610	18665	18719	18774	3	33
9	18829	18883	18938	18992	19047	19101	19156	19210	19265	19319	19373	19427	4	44
10	4.19482	19536	19590	19644	19698	19752	19806	19860	19914	19968	20022	20075	s	
11	20129	20183	20236	20290	20344	20397	20451	20505	20558	20611	20665	20718	1	11
12	20771	20825	20878	20931	20984	21037	21091	21144	21197	21250	21303	21356	2	21
13	21409	21461	21514	21567	21620	21673	21725	21778	21831	21883	21936	21988	3	32
14	22041	22093	22146	22198	22250	22303	22355	22407	22459	22511	22564	22616	4	42
15	4.22668	22720	22772	22824	22876	22928	22980	23031	23083	23135	23187	23238	s	
16	23290	23342	23393	23445	23496	23548	23599	23651	23702	23754	23805	23856	1	10
17	23907	23959	24010	24061	24112	24163	24214	24265	24316	24367	24418	24469	2	20
18	24520	24571	24622	24673	24723	24774	24825	24875	24926	24977	25027	25078	3	31
19	25128	25178	25229	25279	25330	25380	25430	25481	25531	25581	25631	25681	4	41
20	4.25731	25781	25831	25881	25931	25981	26031	26081	26131	26181	26231	26281	s	
21	26330	26380	26429	26479	26529	26578	26628	26677	26727	26776	26826	26875	1	10
22	26924	26974	27023	27072	27121	27171	27220	27269	27318	27367	27416	27465	2	20
23	27514	27563	27612	27661	27710	27759	27807	27856	27905	27954	28002	28051	3	29
24	28099	28148	28197	28245	28294	28342	28391	28439	28487	28536	28584	28632	4	39
25	4.28681	28729	28777	28825	28873	28921	28969	29017	29066	29114	29161	29209	s	
26	29257	29305	29353	29401	29449	29496	29544	29592	29639	29687	29735	29782	1	10
27	29830	29877	29925	29973	30020	30067	30115	30162	30209	30257	30304	30351	2	19
28	30398	30445	30493	30540	30587	30634	30681	30728	30775	30822	30869	30916	3	29
29	30963	31009	31056	31103	31150	31197	31243	31290	31337	31383	31430	31476	4	38
30	4.31523	31569	31616	31662	31709	31755	31801	31848	31894	31940	31987	32033	s	
31	32079	32125	32171	32217	32264	32310	32356	32402	32448	32494	32540	32586	1	9
32	32631	32677	32723	32769	32815	32860	32906	32952	32997	33043	33089	33134	2	18
33	33180	33225	33271	33316	33362	33407	33453	33498	33543	33589	33634	33679	3	28
34	33724	33770	33815	33860	33905	33950	33995	34040	34085	34130	34175	34220	4	37
35	4.34265	34310	34355	34400	34444	34489	34534	34579	34623	34668	34713	34757	s	
36	34802	34847	34891	34936	34980	35025	35069	35114	35158	35202	35247	35291	1	9
37	35335	35380	35424	35468	35512	35556	35601	35645	35689	35733	35777	35821	2	18
38	35865	35909	35953	35997	36041	36085	36128	36172	36216	36260	36303	36347	3	27
39	36391	36435	36478	36522	36565	36609	36653	36696	36740	36783	36827	36870	4	36
40	4.36913	36957	37000	37043	37087	37130	37173	37216	37260	37303	37346	37389	s	
41	37432	37475	37518	37561	37604	37647	37690	37733	37776	37819	37862	37905	1	9
42	37948	37990	38033	38076	38119	38161	38204	38247	38289	38332	38374	38417	2	17
43	38460	38502	38545	38587	38629	38672	38714	38757	38799	38841	38884	38926	3	26
44	38968	39010	39052	39095	39137	39179	39221	39263	39305	39347	39389	39431	4	35
45	4.39473	39515	39557	39599	39641	39683	39725	39766	39808	39850	39892	39933	s	
46	39975	40017	40058	40100	40142	40183	40225	40266	40308	40349	40391	40432	1	8
47	40474	40515	40556	40598	40639	40680	40722	40763	40804	40845	40887	40928	2	17
48	40969	41010	41051	41092	41133	41174	41215	41256	41297	41338	41379	41420	3	25
49	41461	41502	41543	41583	41624	41665	41706	41746	41787	41828	41868	41909	4	34
50	4.41950	41990	42031	42071	42112	42153	42193	42233	42274	42314	42355	42395	s	
51	42435	42476	42516	42556	42597	42637	42677	42717	42758	42798	42838	42878	1	8
52	42918	42958	42998	43038	43078	43118	43158	43198	43238	43278	43318	43258	2	16
53	43398	43437	43477	43517	43557	43597	43636	43676	43716	43755	43795	43835	3	24
54	43874	43914	43953	43993	44032	44072	44111	44151	44190	44229	44269	44308	4	32
55	4.44348	44387	44426	44465	44505	44544	44583	44622	44662	44701	44740	44779	s	
56	44818	44857	44896	44935	44974	45013	45052	45091	45130	45169	45208	45247	1	8
57	45286	45325	45363	45402	45441	45480	45518	45557	45596	45634	45673	45712	2	15
58	45750	45789	45827	45866	45905	45943	45982	46020	46058	46097	46135	46174	3	23
59	46212	46250	46289	46327	46365	46404	46442	46480	46518	46556	46595	46633	4	30

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

3 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	4.46671	46709	46747	46785	46823	46861	46899	46937	46975	47013	47051	47089	s	
1	47127	47165	47203	47241	47278	47316	47354	47392	47430	47467	47505	47543	1	7
2	47580	47618	47656	47693	47731	47768	47806	47843	47881	47918	47956	47993	2	15
3	48031	48068	48106	48143	48180	48218	48255	48292	48330	48367	48404	48441	3	22
4	48479	48516	48553	48590	48627	48664	48701	48739	48776	48813	48850	48887	4	30
5	4.48924	48961	48998	49035	49071	49108	49145	49182	49219	49256	49293	49329	s	
6	49366	49403	49440	49476	49513	49550	49586	49623	49660	49696	49733	49769	1	7
7	49806	49842	49879	49915	49952	49988	50025	50061	50098	50134	50170	50207	2	14
8	50243	50279	50316	50352	50388	50424	50461	50497	50533	50569	50605	50641	3	22
9	50677	50714	50750	50786	50822	50858	50894	50930	50966	51002	51038	51073	4	29
10	4.51109	51145	51181	51217	51253	51289	51324	51360	51396	51432	51467	51503	s	
11	51539	51574	51610	51646	51681	51717	51753	51788	51824	51859	51895	51930	1	7
12	51966	52001	52037	52072	52107	52143	52178	52213	52249	52284	52319	52355	2	14
13	52390	52425	52461	52496	52531	52566	52601	52636	52672	52707	52742	52777	3	21
14	52812	52847	52882	52917	52952	52987	53022	53057	53092	53127	53162	53197	4	28
15	4.53231	53266	53301	53336	53371	53405	53440	53475	53510	53544	53579	53614	s	
16	53648	53683	53718	53752	53787	53821	53856	53891	53925	53960	53994	54029	1	7
17	54063	54097	54132	54166	54201	54235	54269	54304	54338	54372	54407	54441	2	14
18	54475	54509	54544	54578	54612	54646	54680	54715	54749	54783	54817	54851	3	20
19	54885	54919	54953	54987	55021	55055	55089	55123	55157	55191	55225	55259	4	27
20	4.55293	55327	55360	55394	55428	55462	55496	55529	55563	55597	55630	55664	s	
21	55698	55732	55765	55799	55832	55866	55900	55933	55967	56000	56034	56067	1	7
22	56101	56134	56168	56201	56235	56268	56301	56335	56368	56401	56435	56468	2	13
23	56501	56534	56568	56601	56635	56668	56701	56734	56767	56800	56834	56867	3	20
24	56900	56933	56966	56999	57032	57065	57098	57131	57164	57197	57230	57263	4	26
25	4.57296	57329	57362	57395	57428	57460	57493	57526	57559	57592	57625	57657	s	
26	57690	57723	57755	57788	57821	57854	57886	57919	57951	57984	58017	58049	1	6
27	58082	58114	58147	58179	58212	58244	58277	58309	58342	58374	58407	58439	2	13
28	58471	58504	58536	58568	58601	58633	58665	58698	58730	58762	58794	58827	3	19
29	58859	58891	58923	58955	58988	59020	59052	59084	59116	59148	59180	59212	4	26
30	4.59244	59276	59308	59340	59372	59404	59436	59468	59500	59532	59564	59596	s	
31	59627	59659	59691	59723	59755	59786	59818	59850	59882	59913	59945	59977	1	6
32	60008	60040	60072	60103	60135	60167	60198	60230	60261	60293	60324	60356	2	12
33	60388	60419	60450	60482	60513	60545	60576	60608	60639	60670	60701	60733	3	18
34	60764	60796	60827	60858	60890	60921	60952	60983	61015	61046	61077	61108	4	25
35	4.61139	61171	61202	61233	61264	61295	61326	61357	61388	61419	61450	61481	s	
36	61512	61543	61574	61605	61636	61667	61698	61729	61760	61791	61822	61852	1	6
37	61883	61914	61945	61976	62006	62037	62068	62099	62129	62160	62191	62222	2	12
38	62252	62283	62313	62344	62375	62405	62436	62466	62497	62528	62558	62589	3	18
39	62619	62650	62680	62711	62741	62771	62802	62832	62863	62893	62923	62954	4	24
40	4.62984	63014	63045	63075	63105	63136	63166	63196	63226	63257	63287	63317	s	
41	63347	63377	63407	63438	63468	63498	63528	63558	63588	63618	63648	63678	1	6
42	63708	63738	63768	63798	63828	63858	63888	63918	63948	63978	64008	64038	2	12
43	64068	64097	64127	64157	64187	64217	64246	64276	64306	64336	64365	64395	3	18
44	64425	64455	64484	64514	64544	64573	64603	64632	64662	64692	64721	64751	4	24
45	4.64780	64810	64839	64869	64898	64928	64957	64987	65016	65045	65075	65105	s	
46	65134	65163	65193	65222	65251	65281	65310	65339	65369	65398	65427	65456	1	6
47	65486	65515	65544	65573	65603	65632	65661	65690	65719	65748	65777	65806	2	12
48	65836	65865	65894	65923	65952	65981	66010	66039	66068	66097	66126	66155	3	17
49	66184	66213	66242	66270	66299	66328	66357	66386	66415	66444	66472	66501	4	23
50	4.66530	66559	66588	66616	66645	66674	66702	66731	66760	66789	66817	66846	s	
51	66875	66903	66932	66960	66989	67018	67046	67075	67103	67132	67160	67189	1	6
52	67217	67246	67274	67303	67331	67360	67388	67416	67445	67473	67502	67530	2	12
53	67558	67587	67615	67643	67672	67700	67728	67756	67785	67813	67841	67869	3	17
54	67897	67925	67954	67982	68010	68038	68066	68094	68123	68151	68179	68207	4	23
55	4.68235	68263	68291	68319	68347	68375	68403	68431	68459	68487	68515	68543	s	
56	68571	68599	68627	68654	68682	68710	68738	68766	68794	68821	68849	68877	1	6
57	68905	68933	68960	68988	69016	69043	69071	69099	69127	69154	69182	69210	2	11
58	69237	69265	69292	69320	69348	69375	69403	69430	69458	69486	69513	69540	3	17
59	69568	69595	69623	69650	69678	69705	69733	69760	69788	69815	69842	69870	4	22

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

4 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	4.69897	69924	69952	69979	70006	70034	70061	70088	70115	70143	70170	70197	s	
1	70224	70252	70279	70306	70333	70360	70387	70415	70442	70469	70496	70523	1	5
2	70550	70577	70604	70631	70658	70685	70712	70739	70766	70793	70820	70847	2	11
3	70874	70901	70928	70955	70982	71009	71036	71063	71089	71116	71143	71170	3	16
4	71197	71224	71250	71277	71304	71331	71357	71384	71411	71438	71464	71491	4	22
5	4.71518	71544	71571	71598	71624	71651	71678	71704	71731	71757	71784	71810	s	
6	71837	71864	71890	71917	71943	71970	71996	72023	72049	72075	72102	72128	1	5
7	72155	72181	72208	72234	72260	72287	72313	72339	72366	72392	72418	72445	2	10
8	72471	72497	72523	72550	72576	72602	72628	72655	72681	72707	72733	72759	3	16
9	72785	72812	72838	72864	72890	72916	72942	72968	72994	73020	73046	73072	4	21
10	4.73099	73125	73151	73177	73203	73228	73254	73280	73306	73332	73358	73384	s	
11	73410	73436	73462	73488	73514	73539	73565	73591	73617	73643	73668	73694	1	5
12	73720	73746	73772	73797	73823	73849	73874	73900	73926	73951	73977	74003	2	10
13	74028	74054	74080	74105	74131	74157	74182	74208	74233	74259	74284	74310	3	15
14	74335	74361	74386	74412	74437	74463	74488	74514	74539	74565	74590	74616	4	20
15	4.74641	74666	74692	74717	74742	74768	74793	74818	74844	74869	74894	74920	s	
16	74945	74970	74995	75021	75046	75071	75096	75122	75147	75172	75197	75222	1	5
17	75247	75273	75298	75323	75348	75373	75398	75423	75448	75473	75498	75523	2	10
18	75549	75574	75599	75624	75649	75674	75699	75723	75748	75773	75798	75823	3	15
19	75848	75873	75898	75923	75948	75973	75997	76022	76047	76072	76097	76121	4	20
20	4 76146	76171	76196	76221	76245	76270	76295	76320	76344	76369	76394	76418	s	
21	76443	76468	76492	76517	76542	76566	76591	76615	76640	76665	76689	76714	1	5
22	76738	76763	76787	76812	76836	76861	76885	76910	76934	76959	76983	77008	2	10
23	77032	77057	77081	77105	77130	77154	77179	77203	77227	77252	77276	77300	3	15
24	77325	77349	77373	77398	77422	77446	77470	77495	77519	77543	77567	77592	4	20
25	4.77616	77640	77664	77688	77713	77737	77761	77785	77809	77833	77857	77882	s	
26	77906	77930	77954	77978	78002	78026	78050	78074	78098	78122	78146	78170	1	5
27	78194	78218	78242	78266	78290	78314	78338	78361	78385	78409	78433	78457	2	10
28	78481	78505	78529	78552	78576	78600	78624	78648	78671	78695	78719	78743	3	14
29	78767	78790	78814	78838	78861	78885	78909	78933	78956	78980	79004	79027	4	19
30	4.79051	79074	79098	79122	79145	79169	79192	79216	79240	79263	79287	79310	s	
31	79334	79357	79381	79404	79428	79451	79475	79498	79522	79545	79568	79592	1	5
32	79615	79639	79662	79686	79709	79732	79756	79779	79802	79826	79849	79872	2	9
33	79896	79919	79942	79965	79989	80012	80035	80059	80082	80105	80128	80151	3	14
34	80175	80198	80221	80244	80267	80290	80314	80337	80360	80383	80406	80429	4	19
35	4 80452	80475	80498	80521	80545	80568	80591	80614	80637	80660	80683	80706	s	
36	80729	80752	80775	80797	80820	80843	80866	80889	80912	80935	80958	80981	1	5
37	81004	81027	81049	81072	81095	81118	81141	81163	81186	81209	81232	81255	2	9
38	81277	81300	81323	81346	81368	81391	81414	81437	81459	81482	81505	81527	3	14
39	81550	81573	81595	81618	81641	81663	81686	81708	81731	81754	81776	81799	4	18
40	4.81821	81844	81866	81889	81911	81934	81956	81979	82001	82024	82046	82069	s	
41	82091	82114	82136	82159	82181	82203	82226	82248	82271	82293	82315	82338	1	4
42	82360	82382	82405	82427	82449	82472	82494	82516	82538	82561	82583	82605	2	9
43	82628	82650	82672	82694	82716	82739	82761	82783	82805	82827	82850	82872	3	13
44	82894	82916	82938	82960	82982	83004	83026	83049	83071	83093	83115	83137	4	18
45	4.83159	83181	83203	83225	83247	83269	83291	83313	83335	83357	83379	83401	s	
46	83423	83445	83467	83488	83510	83532	83554	83576	83598	83620	83642	83663	1	4
47	83685	83707	83729	83751	83773	83794	83816	83838	83860	83881	83903	83925	2	9
48	83947	83968	83990	84012	84034	84055	84077	84099	84120	84142	84163	84185	3	13
49	84207	84229	84250	84272	84293	84315	84337	84358	84380	84401	84423	84444	4	18
50	4.84466	84488	84509	84531	84552	84574	84595	84617	84638	84659	84681	84702	s	
51	84724	84745	84767	84788	84810	84831	84852	84874	84895	84916	84938	84959	1	4
52	84981	85002	85023	85044	85066	85087	85108	85130	85151	85172	85194	85215	2	9
53	85236	85257	85278	85300	85321	85342	85363	85385	85406	85427	85448	85469	3	13
54	85490	85512	85533	85554	85575	85596	85617	85638	85659	85680	85701	85722	4	17
55	4.85744	85765	85786	85807	85828	85849	85870	85891	85912	85933	85954	85975	s	
56	85996	86017	86038	86058	86079	86100	86121	86142	86163	86184	86205	86226	1	4
57	86247	86267	86288	86309	86330	86351	86372	86392	86413	86434	86455	86475	2	8
58	86496	86517	86538	86559	86579	86600	86621	86641	86662	86683	86704	86724	3	13
59	86745	86766	86786	86807	86828	86848	86869	86889	86910	86931	86951	86972	4	17

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

5 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	4.86992	87013	87034	87054	87075	87095	87116	87136	87157	87177	87198	87218	s	
1	87239	87259	87280	87300	87321	87341	87362	87382	87402	87423	87443	87464	1	4
2	87484	87505	87525	87545	87566	87586	87606	87627	87647	87667	87688	87708	2	8
3	87728	87749	87769	87789	87809	87830	87850	87870	87890	87911	87931	87951	3	12
4	87971	87992	88012	88032	88052	88072	88093	88113	88133	88153	88173	88193	4	16
5	4.88213	88234	88254	88274	88294	88314	88334	88354	88374	88394	88414	88434	s	
6	88454	88474	88494	88514	88534	88554	88574	88594	88614	88634	88654	88674	1	4
7	88694	88714	88734	88754	88774	88794	88814	88834	88853	88873	88893	88913	2	8
8	88933	88953	88973	88992	89012	89032	89052	89072	89091	89111	89131	89151	3	12
9	89171	89190	89210	89230	89250	89269	89289	89309	89328	89348	89368	89388	4	16
10	4.89407	89427	89447	89466	89486	89506	89525	89545	89564	89584	89604	89623	s	
11	89643	89662	89682	89702	89721	89741	89760	89780	89799	89819	89838	89858	1	4
12	89877	89897	89916	89936	89955	89975	89994	90014	90033	90053	90072	90091	2	8
13	90111	90130	90150	90169	90188	90208	90227	90247	90266	90285	90305	90324	3	12
14	90343	90363	90382	90401	90421	90440	90459	90478	90498	90517	90536	90555	4	16
15	4.90575	90594	90613	90632	90652	90671	90690	90709	90728	90748	90767	90786	s	
16	90805	90824	90843	90863	90882	90901	90920	90939	90958	90977	90996	91015	1	4
17	91034	91054	91073	91092	91111	91130	91149	91168	91187	91206	91225	91244	2	8
18	91263	91282	91301	91320	91339	91358	91377	91396	91414	91433	91452	91471	3	11
19	91490	91509	91528	91547	91566	91585	91603	91622	91641	91660	91679	91698	4	15
20	4.91716	91735	91754	91773	91792	91811	91829	91848	91867	91886	91904	91923	s	
21	91942	91961	91979	91998	92017	92035	92054	92073	92092	92110	92129	92148	1	4
22	92166	92185	92203	92222	92241	92259	92278	92297	92315	92334	92352	92371	2	7
23	92390	92408	92427	92445	92464	92483	92501	92519	92538	92556	92575	92593	3	11
24	92612	92630	92649	92667	92686	92704	92723	92741	92760	92778	92796	92815	4	15
25	4.92833	92851	92870	92888	92907	92925	92944	92962	92980	92999	93017	93035	s	
26	93054	93072	93090	93109	93127	93145	93164	93182	93200	93218	93237	93255	1	4
27	93273	93291	93310	93328	93346	93364	93382	93401	93419	93437	93455	93473	2	7
28	93492	93510	93528	93546	93564	93582	93600	93619	93637	93655	93673	93691	3	11
29	93709	93727	93745	93763	93781	93809	93817	93836	93854	93872	93890	93908	4	15
30	4.93926	93944	93962	93980	93998	94016	94034	94052	94069	94088	94105	94123	s	
31	94141	94159	94177	94195	94213	94231	94249	94267	94284	94302	94320	94338	1	4.
32	94356	94374	94392	94410	94427	94445	94463	94481	94498	94516	94534	94552	2	7
33	94570	94587	94605	94623	94641	94658	94676	94694	94711	94729	94747	94765	3	11
34	94782	94800	94818	94835	94853	94871	94888	94906	94924	94941	94959	94976	4	14
35	4.94994	95012	95029	95047	95065	95082	95100	95117	95135	95153	95170	95188	s	
36	95205	95223	95240	95258	95275	95293	95310	95328	95345	95363	95380	95398	1	3
37	95415	95433	95450	95468	95485	95502	95520	95537	95555	95572	95589	95607	2	7
38	95624	95642	95659	95676	95694	95711	95728	95746	95763	95780	95798	95815	3	10
39	95832	95850	95867	95884	95902	95919	95936	95953	95971	95988	96005	96022	4	14
40	4.96040	96057	96074	96091	96109	96126	96143	96160	96177	96195	96212	96229	s	
41	96246	96263	96280	96297	96315	96332	96349	96366	96383	96400	96417	96434	1	3
42	96451	96469	96486	96503	96520	96537	96554	96571	96588	96605	96622	96639	2	7
43	96656	96673	96690	96707	96724	96741	96758	96775	96792	96809	96826	96843	3	10
44	96860	96877	96894	96910	96927	96944	96961	96978	96995	97012	97029	97046	4	14
45	4.97062	97079	97096	97113	97130	97147	97163	97180	97197	97214	97231	97247	s	
46	97264	97281	97298	97315	97331	97348	97365	97382	97398	97415	97432	97449	1	3
47	97465	97482	97499	97515	97532	97549	97565	97582	97599	97615	97632	97649	2	7
48	97665	97682	97699	97715	97732	97749	97765	97782	97798	97815	97832	97848	3	10
49	97865	97881	97898	97914	97931	97947	97964	97981	97997	98014	98030	98047	4	13
50	4.98063	98080	98096	98113	98129	98145	98162	98178	98195	98211	98228	98244	s	
51	98261	98277	98293	98310	98326	98343	98359	98375	98392	98408	98425	98441	1	3
52	98457	98474	98490	98506	98523	98539	98555	98572	98588	98604	98620	98637	2	7
53	98653	98669	98686	98702	98718	98734	98751	98767	98783	98799	98816	98832	3	10
54	98848	98864	98880	98897	98913	98929	98945	98961	98977	98994	99010	99026	4	13
55	4.99042	99058	99074	99090	99107	99123	99139	99155	99171	99187	99203	99219	s	
56	99235	99251	99267	99284	99300	99316	99332	99348	99364	99380	99396	99312	1	3
57	99428	99444	99460	99476	99492	99508	99524	99540	99556	99572	99587	99603	2	6
58	99619	99635	99651	99667	99683	99699	99715	99731	99747	99763	99778	99794	3	10
59	99810	99826	99842	99858	99873	99889	99905	99921	99937	99953	99968	99984	4	13

TABLE XXIX.

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

6 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	5.00000	00016	00932	00047	00063	00079	00095	00110	00126	00142	00158	00173	s	
1	00189	00205	00221	00236	00252	00268	00283	00299	00315	00330	00346	00362	1	3
2	00377	00393	00409	00424	00440	00456	00471	00487	00502	00518	00534	00549	2	6
3	00565	00580	00596	00612	00627	00643	00658	00674	00689	00705	00720	00736	3	9
4	00751	00767	00782	00798	00813	00829	00844	00860	00875	00891	00906	00922	4	12
5	5.00937	00953	00968	00984	00999	01014	01030	01045	01061	01076	01091	01107	s	
6	01122	01138	01153	01168	01184	01199	01214	01230	01245	01260	01276	01291	1	3
7	01306	01322	01337	01352	01368	01383	01398	01413	01429	01444	01459	01474	2	6
8	01490	01505	01520	01536	01551	01566	01581	01596	01612	01627	01642	01657	3	9
9	01672	01688	01703	01718	01733	01748	01763	01779	01794	01809	01824	01839	4	12
10	5.01854	01869	01884	01900	01915	01930	01945	01960	01975	01990	02005	02020	s	
11	02035	02050	02065	02080	02095	02110	02125	02140	02155	02170	02185	02200	1	3
12	02215	02230	02245	02260	02275	02290	02305	02320	02335	02350	02365	02380	2	6
13	02395	02410	02425	02440	02455	02469	02484	02499	02514	02529	02544	02559	3	9
14	02574	02588	02603	02618	02633	02648	02663	02677	02692	02707	02722	02737	4	12
15	5.02751	02766	02781	02796	02811	02825	02840	02855	02870	02884	02899	02914	s	
16	02928	02943	02958	02973	02987	03002	03017	03031	03046	03061	03075	03090	1	3
17	03105	03119	03134	03149	03163	03178	03193	03207	03222	03237	03251	03266	2	6
18	03280	03295	03310	03324	03339	03353	03368	03382	03397	03412	03426	03441	3	9
19	03455	03470	03484	03499	03513	03528	03542	03557	03571	03586	03600	03615	4	12
20	5.03629	03644	03658	03672	03687	03701	03716	03730	03745	03759	03774	03788	s	
21	03802	03817	03831	03846	03860	03874	03889	03903	03918	03932	03946	03961	1	3
22	03975	03989	04004	04018	04032	04047	04061	04075	04090	04104	04118	04132	2	6
23	04147	04161	04175	04190	04204	04218	04232	04247	04261	04275	04289	04303	3	9
24	04318	04332	04346	04360	04375	04389	04403	04417	04431	04445	04460	04474	4	12
25	5.04488	04502	04516	04530	04545	04559	04573	04587	04601	04615	04629	04643	s	
26	04657	04672	04686	04700	04714	04728	04742	04756	04770	04784	04798	04812	1	3
27	04826	04840	04854	04868	04882	04896	04910	04924	04938	04952	04966	04980	2	5
28	04994	05008	05022	05036	05050	05064	05078	05092	05106	05120	05134	05148	3	8
29	05162	05175	05189	05203	05217	05231	05245	05259	05273	05286	05300	05314	4	11
30	5.05328	05342	05356	05370	05383	05397	05411	05425	05439	05452	05466	05480	s	
31	05494	05508	05521	05535	05549	05563	05577	05590	05604	05618	05632	05645	1	3
32	05659	05673	05686	05700	05714	05728	05741	05755	05769	05782	05796	05810	2	5
33	05823	05837	05851	05864	05878	05892	05905	05919	05933	05946	05960	05973	3	8
34	05987	06001	06014	06028	06041	06055	06069	06082	06096	06109	06123	06136	4	10
35	5.06150	06163	06177	06191	06204	06218	06231	06245	06258	06272	06285	06299	s	
36	06312	06326	06339	06353	06366	06379	06393	06406	06420	06433	06447	06460	1	3
37	06474	06487	06500	06514	06527	06541	06554	06567	06581	06594	06608	06621	2	5
38	06634	06648	06661	06674	06688	06701	06714	06728	06741	06754	06768	06781	3	8
39	06794	06808	06821	06834	06848	06861	06874	06887	06901	06914	06927	06941	4	10
40	5.06954	06967	06980	06994	07007	07020	07033	07046	07060	07073	07086	07099	s	
41	07112	07126	07139	07152	07165	07178	07192	07205	07218	07231	07244	07257	1	3
42	07270	07284	07297	07310	07323	07336	07349	07362	07375	07388	07401	07415	2	5
43	07428	07441	07454	07467	07480	07493	07506	07519	07532	07545	07558	07571	3	8
44	07584	07597	07610	07623	07636	07649	07662	07675	07688	07701	07714	07727	4	10
45	5.07740	07753	07766	07779	07792	07805	07818	07831	07844	07857	07869	07882	s	
46	07895	07908	07921	07934	07947	07960	07973	07985	07998	08011	08024	08037	1	3
47	08050	08063	08075	08088	08101	08114	08127	08140	08152	08165	08178	08191	2	5
48	08204	08216	08229	08242	08255	08267	08280	08293	08306	08318	08331	08344	3	8
49	08357	08369	08382	08395	08408	08420	08433	08446	08458	08471	08484	08496	4	10
50	5.08509	08522	08534	08547	08560	08572	08585	08598	08610	08623	08636	08648	s	
51	08661	08673	08686	08699	08711	08724	08736	08749	08762	08774	08787	08799	1	2
52	08812	08824	08837	08850	08862	08875	08887	08900	08912	08925	08937	08950	2	5
53	08962	08975	08987	09000	09012	09025	09037	09050	09062	09075	09087	09100	3	7
54	09112	09124	09137	09149	09162	09174	09187	09199	09211	09224	09236	09249	4	10
55	5.09261	09273	09286	09298	09311	09323	09335	09348	09360	09372	09385	09397	s	
56	09409	09422	09434	09446	09459	09471	09483	09496	09508	09520	09533	09545	1	2
57	09557	09569	09582	09594	09606	09618	09631	09643	09655	09667	09680	09692	2	5
58	09704	09716	09729	09741	09753	09765	09777	09790	09802	09814	09826	09838	3	7
59	09851	09863	09875	09887	09899	09911	09924	09936	09948	09960	09972	09984	4	10

To find the LATITUDE by DOUBLE ALTITUDES, and the ELAPSED TIME.

RISING.

7 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	5.09996	10008	10021	10033	10045	10057	10069	10081	10093	10105	10117	10129	s	
1	10141	10153	10166	10178	10190	10202	10214	10226	10238	10250	10262	10274	1	2
2	10286	10298	10310	10322	10334	10346	10358	10370	10382	10394	10406	10418	2	5
3	10430	10441	10454	10465	10477	10489	10501	10513	10525	10537	10549	10561	3	7
4	10573	10585	10597	10608	10620	10632	10644	10656	10668	10680	10691	10703	4	9
5	5.10715	10727	10739	10751	10763	10774	10786	10798	10810	10822	10833	10845	s	
6	10857	10869	10881	10893	10904	10916	10928	10940	10951	10963	10975	10986	1	2
7	10998	11010	11022	11033	11045	11057	11069	11080	11092	11104	11115	11127	2	5
8	11139	11150	11162	11174	11185	11197	11209	11220	11232	11244	11255	11267	3	7
9	11279	11290	11302	11314	11325	11337	11348	11360	11372	11383	11395	11406	4	9
10	5.11418	11429	11441	11453	11464	11476	11487	11499	11510	11522	11533	11545	s	
11	11557	11568	11580	11591	11603	11614	11626	11637	11649	11660	11672	11683	1	2
12	11695	11706	11717	11729	11740	11752	11763	11775	11786	11798	11809	11820	2	5
13	11832	11843	11855	11866	11878	11889	11900	11912	11923	11934	11946	11957	3	7
14	11969	11980	11991	12003	12014	12025	12037	12048	12059	12071	12082	12093	4	9
15	5.12105	12116	12127	12139	12150	12161	12173	12184	12195	12206	12218	12229	s	
16	12240	12251	12263	12274	12285	12296	12308	12319	12330	12341	12353	12364	1	2
17	12375	12386	12397	12409	12420	12431	12442	12453	12465	12476	12487	12498	2	4
18	12509	12520	12532	12543	12554	12565	12576	12587	12598	12610	12621	12632	3	7
19	12643	12654	12665	12676	12687	12698	12709	12721	12732	12743	12754	12765	4	9
20	5.12776	12787	12798	12809	12820	12831	12842	12853	12864	12875	12886	12897	s	
21	12908	12919	12930	12941	12952	12963	12974	12985	12996	13007	13018	13029	1	2
22	13040	13051	13062	13073	13084	13095	13106	13117	13128	13139	13149	13160	2	4
23	13171	13182	13193	13204	13215	13226	13237	13248	13258	13269	13280	13291	3	7
24	13302	13313	13323	13334	13345	13356	13367	13378	13388	13399	13410	13421	4	9
25	5.13432	13442	13453	13464	13475	13486	13496	13507	13518	13529	13539	13550	s	
26	13561	13572	13582	13593	13604	13615	13625	13636	13647	13658	13668	13679	1	2
27	13690	13700	13711	13722	13732	13743	13754	13765	13775	13786	13797	13807	2	4
28	13818	13828	13839	13850	13860	13871	13882	13892	13903	13914	13924	13935	3	7
29	13945	13956	13967	13977	13988	13998	14009	14019	14030	14041	14051	14062	4	9
30	5.14072	14083	14093	14104	14114	14125	14136	14146	14157	14167	14178	14188	s	
31	14199	14209	14220	14230	14241	14251	14262	14272	14282	14293	14303	14314	1	2
32	14324	14335	14345	14356	14366	14377	14387	14397	14408	14418	14429	14439	2	4
33	14449	14460	14470	14481	14491	14501	14512	14522	14533	14543	14553	14564	3	6
34	14574	14584	14595	14605	14615	14626	14636	14646	14657	14667	14677	14688	4	8
35	5.14698	14708	14719	14729	14739	14750	14760	14770	14780	14790	14801	14811	s	
36	14821	14832	14842	14852	14862	14872	14883	14893	14903	14913	14924	14934	1	2
37	14944	14954	14964	14975	14985	14995	15005	15015	15026	15036	15046	15056	2	4
38	15066	15076	15087	15097	15107	15117	15127	15137	15147	15157	15168	15178	3	6
39	15188	15198	15208	15218	15228	15238	15248	15258	15269	15279	15289	15299	4	8
40	5.15309	15319	15329	15339	15349	15359	15369	15379	15389	15399	15409	15419	s	
41	15429	15439	15449	15459	15469	15479	15489	15499	15509	15519	15529	15539	1	2
42	15549	15559	15569	15579	15589	15599	15609	15619	15629	15639	15649	15659	2	4
43	15668	15678	15688	15698	15708	15718	15728	15738	15748	15758	15767	15777	3	6
44	15787	15797	15807	15817	15827	15837	15846	15856	15866	15876	15886	15896	4	8
45	5.15905	15915	15925	15935	15944	15954	15964	15974	15984	15993	16003	16013	s	
46	16023	16033	16042	16052	16062	16072	16081	16091	16101	16111	16120	16130	1	2
47	16140	16149	16159	16169	16179	16188	16198	16208	16217	16227	16237	16246	2	4
48	16256	16266	16276	16285	16295	16304	16314	16324	16333	16343	16353	16362	3	6
49	16372	16382	16391	16401	16410	16420	16430	16439	16449	16459	16468	16478	4	8
50	5.16487	16497	16506	16516	16526	16535	16545	16554	16564	16573	16583	16592	s	
51	16602	16612	16621	16631	16640	16650	16659	16669	16678	16688	16697	16707	1	2
52	16716	16726	16735	16745	16754	16764	16773	16782	16792	16801	16811	16820	2	4
53	16830	16839	16849	16858	16867	16877	16886	16896	16905	16915	16924	16933	3	6
54	16943	16952	16961	16971	16980	16990	16999	17008	17018	17027	17036	17046	4	8
55	5.17055	17065	17074	17083	17093	17102	17111	17121	17130	17139	17148	17158	s	
56	17167	17176	17186	17195	17204	17214	17223	17232	17241	17251	17260	17269	1	2
57	17278	17288	17297	17306	17315	17325	17334	17343	17352	17362	17371	17380	2	4
58	17389	17398	17408	17417	17426	17435	17444	17454	17463	17472	17481	17490	3	6
59	17499	17509	17518	17527	17536	17545	17554	17563	17573	17582	17591	17600	4	8

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App. Alt		Horizontal Parallax. 53′		54′		55′		56′		57′		58′		59′		60′		61′		Add for Sec. of Par.					
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	0″ ″	2″ ″	4″ ″	6″ ″	8″ ″
3	0	38	21	39	21	40	20	41	20	42	20	43	20	44	20	45	20	46	20	0	0	2	4	6	8
	10	38	52	39	52	40	52	41	52	42	52	43	51	44	51	45	51	46	51	10	10	12	14	16	18
	20	39	21	40	21	41	21	42	21	43	21	44	21	45	21	46	21	47	20	20	20	22	24	26	28
	30	39	49	40	49	41	49	42	48	43	48	44	48	45	48	46	48	47	48	30	30	32	34	36	38
	40	40	13	41	13	42	14	43	14	44	14	45	14	46	14	47	14	48	14	40	40	42	44	46	48
	50	40	39	41	39	42	39	43	39	44	39	45	38	46	38	47	38	48	38	50	50	52	54	56	58
4	0	41	2	42	2	43	2	44	2	45	1	46	1	47	1	48	1	49	1	0	0	2	4	6	8
	10	41	24	42	24	43	23	44	23	45	23	46	23	47	23	48	23	49	22	10	10	12	14	16	18
	20	41	44	42	44	43	44	44	44	45	43	46	43	47	43	48	43	49	43	20	20	22	24	26	28
	30	42	3	43	3	44	3	45	3	46	3	47	2	48	2	49	2	50	2	30	30	32	34	36	38
	40	42	21	43	21	44	21	45	21	46	21	47	21	48	20	49	20	50	20	40	40	42	44	46	48
	50	42	39	43	39	44	38	45	38	46	38	47	38	48	37	49	37	50	37	50	50	52	54	56	58
5	0	42	55	43	55	44	54	45	54	46	54	47	54	48	54	49	53	50	53	0	0	2	4	6	8
	10	43	10	44	10	45	10	46	10	47	9	48	9	49	9	50	9	51	8	10	10	12	14	16	18
	20	43	23	44	23	45	24	46	24	47	24	48	24	49	23	50	23	51	23	20	20	22	24	26	28
	30	43	37	44	38	45	38	46	38	47	38	48	37	49	37	50	37	51	36	30	30	32	34	36	38
	40	43	51	44	51	45	51	46	51	47	51	48	50	49	50	50	50	51	49	40	40	42	44	46	48
	50	44	3	45	3	46	3	47	3	48	3	49	3	50	2	51	2	52	2	50	50	52	54	56	58
6	0	44	15	45	16	46	15	47	15	48	15	49	14	50	14	51	14	52	13	0	0	2	4	6	8
	10	44	27	45	27	46	26	47	26	48	26	49	25	50	25	51	25	52	24	10	10	12	14	16	18
	20	44	38	45	37	46	37	47	37	48	36	49	36	50	35	51	35	52	35	20	20	22	4	26	28
	30	44	49	45	47	46	47	47	47	48	46	49	46	50	45	51	45	52	45	30	30	32	34	36	38
	40	44	58	45	57	46	57	47	56	48	56	49	55	50	55	51	55	52	54	40	40	42	44	46	48
	50	45	7	46	6	47	6	48	5	49	5	50	4	51	4	52	4	53	3	50	50	52	54	56	58
7	0	45	16	46	15	47	14	48	14	49	13	50	13	51	13	52	12	53	12	0	0	2	4	6	8
	10	45	24	46	23	47	22	48	22	49	21	50	21	51	21	52	20	53	20	10	10	12	14	16	18
	20	45	32	46	31	47	30	48	30	49	29	50	29	51	28	52	28	53	27	20	20	22	24	26	28
	30	45	40	46	38	47	38	48	37	49	37	50	36	51	36	52	35	53	35	30	30	32	34	36	38
	40	45	47	46	45	47	45	48	44	49	44	50	43	51	43	52	42	53	42	40	40	42	44	46	48
	50	45	53	46	52	47	52	48	51	49	51	50	50	51	49	52	49	53	48	50	50	52	54	56	58
8	0	46	0	46	59	47	58	48	58	49	57	50	56	51	56	52	55	53	55	0	0	2	4	6	8
	10	46	6	47	5	48	4	49	4	50	3	51	2	52	2	53	1	54	1	10	10	12	14	16	18
	20	46	11	47	11	48	10	49	9	50	9	51	8	52	8	53	7	54	6	20	20	22	24	26	28
	30	46	17	47	16	48	16	49	15	50	14	51	14	52	13	53	12	54	12	30	30	32	34	36	38
	40	46	23	47	22	48	21	49	20	50	20	51	19	52	18	53	17	54	17	40	40	42	44	46	48
	50	46	28	47	27	48	26	49	25	50	25	51	24	52	23	53	22	54	22	50	50	52	54	56	58
9	0	46	33	47	31	48	31	49	30	50	29	51	29	52	28	53	27	54	26	0	0	2	4	6	8
	10	46	37	47	36	48	35	49	35	50	34	51	33	52	32	53	31	54	31	10	10	12	14	16	18
	20	46	41	47	40	48	40	49	39	50	38	51	37	52	36	53	36	54	35	20	20	22	24	26	28
	30	46	45	47	45	48	44	49	43	50	42	51	41	52	40	53	40	54	39	30	30	32	34	36	38
	40	46	49	47	48	48	47	49	47	50	46	51	45	52	44	53	43	54	43	40	39	41	43	45	47
	50	46	53	47	52	48	51	49	50	50	50	51	49	52	48	53	47	54	46	50	49	51	53	55	57

ADD FOR MINUTES OF ALTITUDE.

☽ Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′	☽ Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
3° 0′	3″	6″	9″	13″	16″	19″	22″	25″	28″	6° 0′	1″	2″	3″	4″	5″	7″	8″	9″	10″
10	3	6	9	12	15	18	21	24	27	10	1	2	3	4	5	6	7	8	10
20	2	5	8	11	14	17	19	22	25	20	1	2	3	4	5	6	7	8	9
30	2	5	8	10	13	16	18	21	23	30	1	2	3	4	5	6	7	8	9
40	2	5	7	10	12	15	17	19	22	40	1	2	3	4	5	5	6	7	8
50	2	5	7	9	11	14	16	18	21	50	1	2	3	3	4	5	6	7	8
4 0	2	4	7	9	11	13	15	17	19	7 0	1	2	2	3	4	5	6	7	7
10	2	4	6	8	10	12	14	16	18	10	1	2	2	3	4	5	5	6	7
20	2	4	6	8	10	11	13	15	17	20	1	1	2	3	4	4	5	6	7
30	2	4	5	7	9	11	13	14	16	30	1	1	2	3	3	4	5	6	6
40	2	3	5	7	9	10	12	14	15	40	1	1	2	3	3	4	5	5	6
50	2	3	5	6	8	10	11	13	14	50	1	1	2	3	3	4	5	5	6
5 0	2	3	5	6	8	9	11	12	14	8 0	1	1	2	2	3	3	4	5	5
10	2	3	4	6	7	9	10	12	13	20	1	1	2	2	3	3	4	4	5
20	1	3	4	5	7	8	10	11	12	40	0	1	1	2	2	3	3	4	4
30	1	3	4	5	6	8	9	10	12	9 0	0	1	1	2	2	2	3	4	4
40	1	2	4	5	6	7	9	10	11	20	0	1	1	1	2	2	3	3	4
50	1	2	4	5	6	7	8	9	11	40	0	1	1	1	2	2	2	3	3

TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.	Horizontal Parallax.									Add for Sec. of Par.					
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
3 0	0 44	0 46	0 49	0 51	0 53	0 55	0 57	1 0	1 2	0	0	0	0	0	0
10	0 49	0 51	0 54	0 57	0 59	1 1	1 3	1 6	1 8	10	0	0	1	1	1
20	0 54	0 57	1 0	1 2	1 4	1 6	1 9	1 12	1 14	20	1	1	1	1	1
30	0 59	1 2	1 5	1 8	1 10	1 12	1 15	1 18	1 20	30	1	1	1	2	2
40	1 5	1 7	1 10	1 13	1 15	1 18	1 20	1 23	1 26	40	2	2	2	2	2
50	1 10	1 13	1 16	1 19	1 21	1 23	1 26	1 29	1 32	50	2	2	2	2	2
4 0	1 15	1 18	1 21	1 24	1 26	1 29	1 32	1 35	1 38	0	0	0	0	0	0
10	1 20	1 23	1 26	1 29	1 32	1 35	1 38	1 41	1 44	10	0	1	1	1	1
20	1 26	1 29	1 32	1 35	1 38	1 41	1 44	1 47	1 50	20	1	1	1	1	1
30	1 31	1 34	1 37	1 40	1 43	1 47	1 50	1 53	1 56	30	1	2	2	2	2
40	1 36	1 39	1 42	1 46	1 49	1 52	1 55	1 59	2 2	40	2	2	2	2	2
50	1 41	1 45	1 48	1 51	1 54	1 58	2 1	2 5	2 8	50	2	3	3	3	3
5 0	1 46	1 50	1 53	1 57	2 0	2 4	2 7	2 11	2 14	0	0	0	0	0	1
10	1 52	1 55	1 59	2 3	2 6	2 10	2 13	2 17	2 20	10	1	1	1	1	1
20	1 57	2 1	2 4	2 8	2 12	2 16	2 19	2 23	2 26	20	1	1	2	2	2
30	2 2	2 6	2 10	2 14	2 18	2 22	2 25	2 29	2 33	30	2	2	2	2	3
40	2 7	2 11	2 15	2 19	2 23	2 27	2 31	2 35	2 39	40	3	3	3	3	3
50	2 13	2 17	2 21	2 25	2 28	2 32	2 36	2 41	2 45	50	3	3	3	4	4
6 0	2 18	2 22	2 26	2 30	2 34	2 38	2 42	2 47	2 51	0	0	0	0	0	1
10	2 24	2 28	2 32	2 36	2 40	2 44	2 48	2 53	2 57	10	1	1	1	1	1
20	2 29	2 33	2 37	2 41	2 46	2 50	2 54	2 59	3 3	20	1	2	2	2	2
30	2 34	2 39	2 43	2 47	2 52	2 56	3 0	3 5	3 9	30	2	2	2	3	3
40	2 39	2 44	2 48	2 53	2 57	3 2	3 6	3 11	3 15	40	3	3	3	3	4
50	2 45	2 50	2 54	2 58	3 3	3 8	3 12	3 17	3 21	50	4	4	4	4	4
7 0	2 50	2 55	2 59	3 4	3 9	3 14	3 18	3 23	3 28	0	0	0	0	0	1
10	2 55	3 0	3 5	3 10	3 15	3 20	3 24	3 29	3 34	10	1	1	1	1	1
20	3 1	3 6	3 10	3 15	3 20	3 25	3 30	3 35	3 40	20	2	2	2	2	2
30	3 6	3 11	3 16	3 21	3 26	3 31	3 36	3 41	3 46	30	2	3	3	3	3
40	3 11	3 16	3 21	3 26	3 32	3 37	3 42	3 47	3 52	40	3	3	4	4	4
50	3 16	3 22	3 27	3 32	3 37	3 42	3 48	3 53	3 58	50	4	4	4	5	5
8 0	3 22	3 27	3 32	3 37	3 43	3 48	3 54	3 59	4 4	0	0	0	0	1	1
10	3 27	3 33	3 38	3 43	3 49	3 54	4 0	4 5	4 10	10	1	1	1	1	2
20	3 32	3 38	3 43	3 48	3 54	4 0	4 6	4 11	4 16	20	2	2	2	2	2
30	3 37	3 43	3 49	3 54	4 0	4 6	4 12	4 17	4 23	30	3	3	3	3	3
40	3 43	3 48	3 54	4 0	4 6	4 11	4 17	4 23	4 29	40	4	4	4	4	4
50	3 48	3 54	4 0	4 5	4 11	4 17	4 23	4 29	4 35	50	5	5	5	5	5
9 0	3 53	3 59	4 5	4 11	4 17	4 23	4 29	4 35	4 41	0	0	0	0	1	1
10	3 59	4 4	4 11	4 17	4 23	4 29	4 35	4 41	4 47	10	1	1	1	2	2
20	4 4	4 10	4 16	4 22	4 28	4 34	4 41	4 47	4 53	20	2	2	2	3	3
30	4 9	4 15	4 22	4 28	4 34	4 40	4 47	4 53	4 59	30	3	3	3	4	4
40	4 14	4 20	4 27	4 33	4 40	4 46	4 52	4 58	5 5	40	4	4	4	5	5
50	4 20	4 26	4 33	4 39	4 45	4 51	4 58	5 4	5 11	50	5	5	5	6	6

Add for Alt. of Sun.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.

	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

ADD FOR MINUTES OF ALTITUDE.

☽ Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′	☽ Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
3° 0′	1″	1″	2″	2″	3″	3″	4″	4″	5″	6° 0′	1″	1″	2″	2″	3″	3″	4″	4″	5″
10	1	1	2	2	3	3	4	4	5	10	1	1	2	2	3	3	4	4	5
20	1	1	2	2	3	3	4	4	5	20	1	1	2	2	3	3	4	4	5
30	1	1	2	2	3	3	4	4	5	30	1	1	2	2	3	3	4	4	5
40	1	1	2	2	3	3	4	4	5	40	1	1	2	2	3	3	4	4	5
50	1	1	2	2	3	3	4	4	5	50	1	1	2	2	3	3	4	4	5
4 0	1	1	2	2	3	3	4	4	5	7 0	1	1	2	2	3	3	4	4	5
10	1	1	2	2	3	3	4	4	5	10	1	1	2	2	3	3	4	4	5
20	1	1	2	2	3	3	4	4	5	20	1	1	2	2	3	3	4	4	5
30	1	1	2	2	3	3	4	4	5	30	1	1	2	2	3	3	4	4	5
40	1	1	2	2	3	3	4	4	5	40	1	1	2	2	3	3	4	4	5
50	1	1	2	2	3	3	4	4	5	50	1	1	2	2	3	3	4	4	5
5 0	1	1	2	2	3	3	4	4	5	8 0	1	1	2	2	3	3	4	4	5
10	1	1	2	2	3	3	4	4	5	20	1	1	2	2	3	3	4	4	5
20	1	1	2	2	3	3	4	4	5	40	1	1	2	2	3	3	4	4	5
30	1	1	2	2	3	3	4	4	5	9 0	1	1	2	2	3	3	4	4	5
40	1	1	2	2	3	3	4	4	5	20	1	1	2	2	3	3	4	4	5
50	1	1	2	2	3	3	4	4	5	40	1	1	2	2	3	3	4	4	5

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4′	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″
10	0	46	57	47	56	48	55	49	54	50	53	51	52	52	51	53	50	54	49	0	0	2	4	6	8
	10	47	0	47	59	48	58	49	57	50	56	51	55	52	54	53	53	54	52	10	10	12	14	16	18
	20	47	3	48	2	49	1	50	0	50	59	51	58	52	57	53	56	54	55	20	20	22	24	26	28
	30	47	6	48	5	49	4	50	3	51	2	52	1	53	0	53	59	54	58	30	29	31	33	35	37
	40	47	9	48	8	49	7	50	6	51	5	52	4	53	3	54	2	55	1	40	39	41	43	45	47
	50	47	12	48	11	49	10	50	9	51	8	52	7	53	6	54	4	55	3	50	49	51	53	55	57
11	0	47	14	48	13	49	12	50	11	51	10	52	9	53	8	54	7	55	6	0	0	2	4	6	8
	10	47	17	48	16	49	15	50	14	51	12	52	11	53	10	54	9	55	8	10	10	12	14	16	18
	20	47	19	48	18	49	17	50	16	51	14	52	13	53	12	54	11	55	10	20	20	22	24	25	27
	30	47	22	48	20	49	19	50	18	51	16	52	15	53	14	54	13	55	12	30	29	31	33	35	37
	40	47	23	48	22	49	21	50	20	51	18	52	17	53	16	54	15	55	14	40	39	41	43	45	47
	50	47	25	48	24	49	23	50	22	51	20	52	19	53	18	54	16	55	16	50	49	51	53	55	57
12	0	47	27	48	26	49	25	50	23	51	22	52	21	53	19	54	18	55	17	0	0	2	4	6	8
	10	47	29	48	27	49	26	50	25	51	23	52	22	53	21	54	19	55	18	10	10	12	14	16	18
	20	47	31	48	29	49	28	50	26	51	25	52	23	53	22	54	21	55	19	20	20	21	23	25	27
	30	47	32	48	30	49	29	50	27	51	26	52	25	53	23	54	22	55	20	30	29	31	33	35	37
	40	47	34	48	32	49	30	50	29	51	27	52	26	53	24	54	23	55	21	40	39	41	43	45	47
	50	47	35	48	33	49	31	50	30	51	28	52	27	53	25	54	24	55	22	50	49	51	53	55	57
13	0	47	35	48	34	49	32	50	31	51	29	52	28	53	26	54	25	55	23	0	0	2	4	6	8
	10	47	36	48	35	49	33	50	32	51	30	52	28	53	27	54	25	55	24	10	10	12	14	16	18
	20	47	37	48	36	49	34	50	32	51	31	52	29	53	28	54	26	55	24	20	19	21	23	25	27
	30	47	38	48	36	49	35	50	33	51	31	52	30	53	28	54	26	55	25	30	29	31	33	35	37
	40	47	39	48	37	49	35	50	34	51	32	52	30	53	29	54	27	55	25	40	39	41	43	45	47
	50	47	40	48	38	49	36	50	34	51	32	52	31	53	29	54	27	55	25	50	49	51	53	54	56
14	0	47	40	48	38	49	36	50	35	51	33	52	31	53	29	54	27	55	26	0	0	2	4	6	8
	10	47	41	48	39	49	37	50	35	51	33	52	31	53	29	54	28	55	26	10	10	12	14	15	17
	20	47	41	48	39	49	37	50	35	51	33	52	31	53	30	54	28	55	26	20	19	21	23	25	27
	30	47	41	48	39	49	37	50	35	51	33	52	31	53	30	54	28	55	26	30	29	31	33	35	37
	40	47	41	48	39	49	37	50	35	51	33	52	31	53	30	54	28	55	26	40	39	41	43	45	46
	50	47	41	48	39	49	37	50	35	51	33	52	31	53	29	54	27	55	25	50	48	50	52	54	56
15	0	47	41	48	39	49	37	50	35	51	33	52	31	53	29	54	27	55	25	0	0	2	4	6	8
	10	47	41	48	39	49	37	50	35	51	33	52	31	53	29	54	27	55	25	10	10	12	14	15	17
	20	47	41	48	39	49	37	50	35	51	33	52	31	53	28	54	26	55	24	20	19	21	23	25	27
	30	47	41	48	39	49	37	50	34	51	32	52	30	53	28	54	26	55	24	30	29	31	33	35	37
	40	47	41	48	39	49	36	50	34	51	32	52	30	53	27	54	25	55	23	40	39	40	42	44	46
	50	47	40	48	38	49	36	50	34	51	31	52	29	53	27	54	24	55	22	50	48	50	52	54	56
16	0	47	30	48	28	49	25	50	23	51	21	52	18	53	16	54	14	55	11	0	0	2	4	6	8
	10	47	30	48	27	49	25	50	22	51	20	52	18	53	15	54	13	55	10	10	10	11	13	15	17
	20	47	29	48	27	49	24	50	22	51	19	52	17	53	15	54	12	55	9	20	19	21	23	25	27
	30	47	29	48	26	49	23	50	21	51	19	52	16	53	14	54	11	55	8	30	29	31	33	35	37
	40	47	29	48	25	49	23	50	20	51	18	52	15	53	13	54	10	55	7	40	38	40	42	44	46
	50	47	28	48	24	49	22	50	19	51	17	52	14	53	12	54	9	55	6	50	48	50	52	54	56
17	0	47	27	48	24	49	21	50	18	51	16	52	13	53	11	54	8	55	5	0	0	2	4	6	8
	10	47	25	48	23	49	20	50	17	51	15	52	12	53	9	54	7	55	4	10	10	11	13	15	17
	20	47	24	48	22	49	19	50	16	51	14	52	11	53	8	54	5	55	3	20	19	21	23	25	27
	30	47	24	48	21	49	18	50	15	51	12	52	10	53	7	54	4	55	1	30	29	30	32	34	36
	40	47	23	48	20	49	17	50	14	51	11	52	8	53	6	54	3	55	0	40	38	40	42	44	46
	50	47	22	48	19	49	16	50	13	51	10	52	7	53	4	54	1	54	58	50	48	50	52	53	55
18	0	47	20	48	17	49	14	50	12	51	9	52	6	53	3	54	0	54	57	0	0	2	4	6	8
	10	47	20	48	16	49	13	50	10	51	7	52	4	53	1	53	58	54	55	10	9	11	13	15	17
	20	47	18	48	15	49	12	50	9	51	6	52	3	53	0	53	57	54	54	20	19	21	23	25	27
	30	47	16	48	13	49	10	50	7	51	4	52	1	52	58	53	55	54	52	30	28	30	32	34	36
	40	47	15	48	12	49	9	50	6	51	3	51	59	52	56	53	53	54	50	40	38	40	42	44	46
	50	47	14	48	11	49	7	50	4	51	1	51	58	52	55	53	51	54	48	50	47	49	51	53	55
19	0	47	13	48	9	49	6	50	3	50	59	51	56	52	53	53	50	54	46	0	0	2	4	6	8
	10	47	11	48	8	49	4	50	1	50	58	51	54	52	51	53	48	54	44	10	9	11	13	15	17
	20	47	10	48	6	49	3	49	59	50	56	51	52	52	49	53	46	54	42	20	19	21	23	25	27
	30	47	8	48	4	49	1	49	57	50	54	51	51	52	47	53	44	54	40	30	28	30	32	34	36
	40	47	6	48	3	48	59	49	56	50	52	51	49	52	45	53	42	54	38	40	38	40	42	44	46
	50	47	4	48	1	48	57	49	54	50	50	51	47	52	43	53	39	54	36	50	47	49	51	53	55

Add for Minutes of Alt.

′	″
0	0
1	0
2	0
3	1
4	1
5	1
6	1
7	2
8	2
9	2

′	″
0	0
1	0
2	0
3	0
4	0
5	0
6	1
7	1
8	1
9	1

′	″
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0

′	″
0	10
1	10
2	10
3	10
4	10
5	9
6	9
7	9
8	9
9	9

′	″
0	10
1	10
2	10
3	10
4	9
5	9
6	9
7	9
8	9
9	9

TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.									Add for Sec. of Par					
		53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
°	′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	′	″	″	″	″
10	0	4 25	4 31	4 38	4 44	4 51	4 57	5 4	5 10	5 17	0	0	0	0	1	1
	10	4 30	4 37	4 44	4 50	4 57	5 3	5 10	5 16	5 23	10	1	1	2	2	2
	20	4 35	4 42	4 49	4 55	5 2	5 9	5 16	5 22	5 29	20	2	2	3	3	3
	30	4 41	4 47	4 54	5 1	5 8	5 15	5 22	5 28	5 35	30	3	4	4	4	4
	40	4 46	4 53	5 0	5 7	5 14	5 20	5 27	5 34	5 41	40	4	5	5	5	5
	50	4 51	4 58	5 5	5 12	5 19	5 26	5 33	5 40	5 47	50	6	6	6	6	6
11	0	4 56	5 3	5 11	5 18	5 25	5 32	5 39	5 46	5 53	0	0	0	0	1	1
	10	5 2	5 9	5 16	5 24	5 31	5 38	5 45	5 52	5 59	10	1	1	2	2	2
	20	5 7	5 14	5 22	5 29	5 36	5 43	5 51	5 58	6 5	20	2	3	3	3	3
	30	5 12	5 19	5 27	5 35	5 42	5 49	5 57	6 4	6 11	30	4	4	4	4	5
	40	5 17	5 24	5 32	5 40	5 47	5 55	6 2	6 10	6 17	40	5	5	5	6	6
	50	5 23	5 30	5 38	5 46	5 53	6 0	6 8	6 16	6 23	50	6	6	7	7	7
12	0	5 28	5 35	5 43	5 51	5 58	6 6	6 14	6 22	6 29	0	0	0	1	1	1
	10	5 33	5 40	5 48	5 56	6 4	6 12	6 20	6 28	6 35	10	1	2	2	2	2
	20	5 38	5 46	5 54	6 2	6 10	6 18	6 26	6 34	6 41	20	3	3	3	3	4
	30	5 43	5 51	5 59	6 7	6 15	6 23	6 31	6 39	6 47	30	4	4	5	5	5
	40	5 49	5 57	6 5	6 13	6 21	6 29	6 37	6 45	6 53	40	5	6	6	6	6
	50	5 54	6 2	6 10	6 18	6 27	6 35	6 43	6 51	6 59	50	7	7	7	7	8
13	0	5 59	6 7	6 15	6 24	6 32	6 40	6 49	6 57	7 5	0	0	0	1	1	1
	10	6 4	6 12	6 21	6 30	6 38	6 46	6 55	7 3	7 11	10	1	2	2	2	3
	20	6 9	6 18	6 26	6 35	6 43	6 51	7 0	7 9	7 17	20	3	3	3	4	4
	30	6 15	6 23	6 32	6 41	6 49	6 57	7 6	7 15	7 23	30	4	4	5	5	5
	40	6 20	6 28	6 37	6 46	6 55	7 3	7 12	7 20	7 29	40	6	6	6	6	7
	50	6 25	6 34	6 43	6 52	7 0	7 8	7 17	7 26	7 35	50	7	7	8	8	8
14	0	6 30	6 39	6 48	6 57	7 6	7 14	7 23	7 32	7 41	0	0	0	1	1	1
	10	6 35	6 44	6 53	7 2	7 11	7 20	7 29	7 38	7 47	10	1	2	2	2	3
	20	6 41	6 50	6 59	7 8	7 17	7 26	7 35	7 44	7 53	20	3	3	4	4	4
	30	6 46	6 55	7 4	7 13	7 22	7 31	7 41	7 50	7 59	30	4	5	5	5	6
	40	6 51	7 0	7 9	7 18	7 28	7 37	7 46	7 55	8 5	40	6	6	7	7	7
	50	6 56	7 6	7 15	7 24	7 33	7 42	7 52	8 1	8 11	50	8	8	8	8	9
15	0	7 1	7 11	7 20	7 29	7 39	7 48	7 58	8 7	8 17	0	0	0	1	1	1
	10	7 6	7 16	7 25	7 35	7 45	7 54	8 4	8 13	8 23	10	2	2	2	3	3
	20	7 11	7 21	7 31	7 40	7 50	7 59	8 9	8 19	8 29	20	3	3	4	4	4
	30	7 17	7 27	7 36	7 46	7 56	8 5	8 15	8 25	8 35	30	5	5	5	6	6
	40	7 22	7 32	7 41	7 51	8 1	8 11	8 21	8 30	8 40	40	6	7	7	7	8
	50	7 27	7 37	7 47	7 57	8 7	8 16	8 26	8 36	8 46	50	8	8	9	9	9
16	0	7 32	7 42	7 52	8 2	8 12	8 22	8 32	8 42	8 52	0	0	0	1	1	1
	10	7 37	7 47	7 57	8 7	8 18	8 28	8 38	8 48	8 58	10	2	2	2	3	3
	20	7 42	7 52	8 3	8 13	8 23	8 33	8 43	8 54	9 4	20	3	4	4	4	5
	30	7 47	7 58	8 8	8 18	8 29	8 39	8 49	9 0	9 10	30	5	6	6	6	7
	40	7 52	8 3	8 13	8 23	8 34	8 45	8 55	9 5	9 15	40	7	7	8	8	8
	50	7 57	8 8	8 19	8 29	8 40	8 50	9 0	9 11	9 21	50	9	9	9	10	10
17	0	8 2	8 13	8 24	8 34	8 45	8 56	9 6	9 17	9 27	0	0	0	1	1	1
	10	8 8	8 18	8 29	8 40	8 51	9 2	9 12	9 23	9 33	10	2	2	3	3	3
	20	8 13	8 23	8 34	8 45	8 56	9 7	9 17	9 28	9 39	20	4	4	4	5	5
	30	8 18	8 29	8 39	8 50	9 1	9 12	9 23	9 34	9 45	30	5	6	6	7	7
	40	8 23	8 34	8 45	8 56	9 7	9 18	9 29	9 40	9 51	40	7	8	8	8	9
	50	8 28	8 39	8 50	9 1	9 12	9 23	9 35	9 46	9 57	50	9	9	10	10	10
18	0	8 33	8 44	8 55	9 6	9 18	9 29	9 40	9 51	10 2	0	0	0	1	1	2
	10	8 38	8 49	9 0	9 11	9 23	9 35	9 46	9 57	10 8	10	2	2	3	3	3
	20	8 43	8 54	9 6	9 17	9 29	9 40	9 51	10 2	10 14	20	4	4	5	5	5
	30	8 48	9 0	9 11	9 22	9 34	9 46	9 57	10 8	10 20	30	6	6	7	7	7
	40	8 53	9 5	9 16	9 27	9 39	9 51	10 3	10 14	10 25	40	8	8	8	9	9
	50	8 58	9 10	9 22	9 33	9 45	9 57	10 8	10 19	10 31	50	9	10	10	11	11
19	0	9 3	9 15	9 27	9 38	9 50	10 2	10 14	10 25	10 37	0	0	0	1	1	2
	10	9 8	9 20	9 32	9 44	9 56	10 8	10 20	10 31	10 43	10	2	2	3	3	4
	20	9 13	9 25	9 37	9 49	10 1	10 13	10 25	10 37	10 49	20	4	4	5	5	6
	30	9 18	9 30	9 42	9 54	10 6	10 19	10 31	10 43	10 55	30	6	6	7	7	8
	40	9 23	9 36	9 48	10 0	10 12	10 24	10 36	10 48	11 0	40	8	8	9	9	10
	50	9 28	9 41	9 53	10 5	10 17	10 30	10 42	10 54	11 6	50	10	10	11	11	12

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	1″	1″	2″	2″	3″	3″	4″	4″	5″

Add for Alt. of SUN.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of STAR.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.						Add for Minutes of Alt.	
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″		
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″		
20	0	47	3	47	59	48	55	49	52	50	48	51	45	52	41	53	37	54	34	0	0	2	4	6	8	′	″
	10	47	1	47	57	48	53	49	50	50	46	51	42	52	39	53	35	54	31	10	9	11	13	15	17	0	10
	20	47	0	47	55	48	51	49	48	50	44	51	40	52	36	53	33	54	29	20	19	21	22	24	26	1	10
	30	46	58	47	53	48	49	49	46	50	42	51	38	52	34	53	30	54	27	30	28	30	32	34	36	2	10
	40	46	56	47	51	48	47	49	43	50	40	51	36	52	32	53	28	54	24	40	37	39	41	43	45	3	9
	50	46	54	47	49	48	45	49	41	50	37	51	34	52	30	53	26	54	22	50	47	49	51	52	54	4	9
21	0	46	52	47	47	48	43	49	39	50	35	51	31	52	27	53	23	54	19	0	0	2	4	6	7	5	9
	10	46	50	47	45	48	41	49	37	50	33	51	29	52	25	53	21	54	17	10	9	11	13	15	17	6	9
	20	46	47	47	43	48	39	49	35	50	30	51	26	52	22	53	18	54	14	20	19	21	22	24	26	7	8
	30	46	45	47	41	48	36	49	32	50	28	51	24	52	20	53	16	54	11	30	28	30	31	33	35	8	8
	40	46	43	47	38	48	34	49	30	50	26	51	21	52	17	53	13	54	9	40	37	39	41	43	45	9	8
	50	46	41	47	36	48	32	49	27	50	23	51	19	52	15	53	10	54	6	50	47	48	50	52	54		
22	0	46	39	47	34	48	29	49	25	50	21	51	16	52	12	53	8	54	3	0	0	2	4	6	7		
	10	46	36	47	31	48	27	49	22	50	18	51	14	52	9	53	5	54	0	10	9	11	13	15	17	′	″
	20	46	33	47	29	48	24	49	20	50	15	51	11	52	6	53	2	53	57	20	18	20	22	24	26	0	10
	30	46	31	47	26	48	22	49	17	50	13	51	8	52	4	52	59	53	54	30	28	30	31	33	35	1	10
	40	46	29	47	24	48	19	49	15	50	10	51	5	52	1	52	56	53	51	40	37	39	41	43	44	2	9
	50	46	26	47	21	48	17	49	12	50	7	51	3	51	58	52	53	53	48	50	46	48	50	52	54	3	9
23	0	46	23	47	19	48	14	49	9	50	4	51	0	51	55	52	50	53	45	0	0	2	4	6	7	4	9
	10	46	20	47	16	48	11	49	6	50	2	50	57	51	52	52	47	53	42	10	9	11	13	15	17	5	8
	20	46	17	47	13	48	9	49	4	49	59	50	54	51	49	52	44	53	39	20	18	20	22	24	26	6	8
	30	46	15	47	11	48	6	49	1	49	56	50	51	51	46	52	41	53	36	30	28	29	31	33	35	7	8
	40	46	12	47	8	48	3	48	58	49	53	50	48	51	43	52	38	53	33	40	37	39	40	42	44	8	8
	50	46	10	47	5	48	0	48	55	49	50	50	45	51	40	52	34	53	29	50	46	48	50	51	53	9	7
24	0	46	7	47	2	47	57	48	52	49	47	50	42	51	37	52	31	53	26	0	0	2	4	5	7		
	10	46	4	47	0	47	54	48	49	49	44	50	38	51	33	52	28	53	23	10	9	11	13	15	16	′	″
	20	46	1	46	57	47	51	48	46	49	41	50	35	51	30	52	25	53	19	20	18	20	22	24	25	0	10
	30	45	58	46	54	47	48	48	43	49	37	50	32	51	27	52	21	53	16	30	27	29	31	33	35	1	10
	40	45	55	46	51	47	45	48	40	49	34	50	29	51	23	52	18	53	12	40	36	38	40	42	44	2	9
	50	45	53	46	48	47	42	48	37	49	31	50	25	51	20	52	14	53	9	50	46	47	49	51	53	3	9
25	0	45	50	46	45	47	39	48	33	49	28	50	22	51	17	52	11	53	5	0	0	2	4	5	7	4	9
	10	45	47	46	42	47	36	48	30	49	24	50	19	51	13	52	7	53	2	10	9	11	13	14	16	5	8
	20	45	44	46	38	47	33	48	27	49	21	50	15	51	10	52	4	52	58	20	18	20	22	23	25	6	8
	30	45	41	46	35	47	29	48	24	49	18	50	12	51	6	52	0	52	54	30	27	29	31	32	34	7	8
	40	45	38	46	32	47	26	48	20	49	14	50	8	51	3	51	57	52	51	40	36	38	40	41	43	8	7
	50	45	35	46	29	47	23	48	17	49	11	50	5	50	59	51	53	52	47	50	45	47	49	51	52	9	7
26	0	45	32	46	26	47	20	48	13	49	7	50	1	50	55	51	49	52	43	0	0	2	4	5	7		
	10	45	29	46	22	47	16	48	10	49	4	49	58	50	52	51	45	52	39	10	9	11	13	14	16	′	″
	20	45	25	46	19	47	13	48	7	49	0	49	54	50	48	51	42	52	35	20	18	20	21	23	25	0	10
	30	45	22	46	16	47	9	48	3	48	57	49	50	50	44	51	38	52	31	30	27	29	30	32	34	1	10
	40	45	19	46	12	47	6	47	59	48	53	49	47	50	40	51	34	52	28	40	36	38	40	41	43	2	9
	50	45	16	46	9	47	2	47	56	48	49	49	43	50	36	51	30	52	24	50	45	47	48	50	52	3	9
27	0	45	12	46	5	46	59	47	52	48	46	49	39	50	33	51	26	52	20	0	0	2	4	5	7	4	9
	10	45	9	46	2	46	55	47	49	48	42	49	35	50	29	51	22	52	16	10	9	11	12	14	16	5	8
	20	45	5	45	58	46	52	47	45	48	38	49	32	50	25	51	18	52	11	20	18	20	21	23	25	6	8
	30	45	2	45	55	46	48	47	41	48	34	49	28	50	21	51	14	52	7	30	27	28	30	32	34	7	7
	40	44	58	45	51	46	44	47	37	48	30	49	24	50	17	51	10	52	3	40	35	37	39	41	43	8	7
	50	44	54	45	48	46	41	47	34	48	27	49	20	50	13	51	6	51	59	50	44	46	48	50	51	9	6
28	0	44	51	45	44	46	37	47	30	48	23	49	16	50	9	51	2	51	55	0	0	2	4	5	7		
	10	44	47	45	40	46	33	47	26	48	19	49	12	50	5	50	58	51	50	10	9	11	12	14	16	′	″
	20	44	43	45	36	46	29	47	22	48	15	49	8	50	0	50	54	51	46	20	18	19	21	23	25	0	10
	30	44	40	45	33	46	25	47	18	48	11	49	4	49	56	50	49	51	42	30	27	28	30	32	33	1	10
	40	44	36	45	29	46	22	47	14	48	7	48	59	49	52	50	45	51	37	40	35	37	39	40	42	2	9
	50	44	32	45	25	46	18	47	10	48	3	48	55	49	48	50	40	51	33	50	44	46	47	49	51	3	9
29	0	44	29	45	21	46	14	47	6	47	59	48	51	49	44	50	36	51	29	0	0	2	3	5	7	4	8
	10	44	25	45	17	46	10	47	2	47	55	48	47	49	39	50	32	51	24	10	9	10	12	14	16	5	8
	20	44	21	45	13	46	6	46	58	47	50	48	43	49	35	50	27	51	20	20	17	19	21	23	24	6	7
	30	44	18	45	9	46	2	46	54	47	46	48	38	49	31	50	23	51	15	30	26	28	30	31	33	7	7
	40	44	14	45	5	45	58	46	50	47	42	48	34	49	26	50	18	51	10	40	35	37	38	40	42	8	7
	50	44	10	45	1	45	54	46	46	47	38	48	30	49	22	50	14	51	6	50	44	45	47	49	50	9	6

TABLE XXX.*

AUXILIARY ARCS.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″
20	0	9	33	9	46	9	58	10	10	10	22	10	35	10	47	10	59	11	12	0	0	0	1	1	2
	10	9	38	9	51	10	3	10	16	10	28	10	40	10	53	11	5	11	18	10	2	3	3	3	4
	20	9	43	9	56	10	8	10	21	10	33	10	46	10	58	11	11	11	23	20	4	5	5	5	6
	30	9	48	10	1	10	14	10	26	10	39	10	51	11	4	11	16	11	29	30	6	7	7	7	8
	40	9	53	10	6	10	19	10	31	10	44	10	57	11	10	11	22	11	35	40	8	9	9	10	10
	50	9	58	10	11	10	24	10	37	10	49	11	2	11	15	11	28	11	41	50	10	11	11	12	12
21	0	10	3	10	16	10	29	10	42	10	55	11	8	11	20	11	33	11	46	0	0	0	1	1	2
	10	10	8	10	21	10	34	10	47	11	0	11	13	11	26	11	39	11	52	10	2	3	3	3	4
	20	10	13	10	26	10	39	10	52	11	5	11	19	11	32	11	45	11	58	20	4	5	5	6	6
	30	10	18	10	31	10	45	10	58	11	11	11	24	11	37	11	50	12	3	30	7	7	7	8	8
	40	10	23	10	36	10	50	11	3	11	16	11	29	11	42	11	56	12	9	40	9	9	10	10	11
	50	10	28	10	41	10	55	11	8	11	21	11	35	11	48	12	1	12	15	50	11	11	12	12	13
22	0	10	33	10	46	11	0	11	13	11	26	11	40	11	53	12	7	12	20	0	0	0	1	1	2
	10	10	38	10	51	11	5	11	18	11	32	11	45	11	59	12	12	12	26	10	2	3	3	4	4
	20	10	43	10	56	11	10	11	23	11	37	11	51	12	5	12	18	12	32	20	5	5	5	6	6
	30	10	48	11	1	11	15	11	29	11	42	11	56	12	10	12	24	12	37	30	7	7	8	8	9
	40	10	53	11	6	11	20	11	34	11	48	12	2	12	15	12	29	12	43	40	9	9	10	10	11
	50	10	57	11	11	11	25	11	39	11	53	12	7	12	21	12	35	12	49	50	11	12	12	13	13
23	0	11	2	11	16	11	30	11	44	11	58	12	12	12	26	12	40	12	54	0	0	0	1	1	2
	10	11	7	11	21	11	35	11	49	12	3	12	18	12	32	12	46	13	0	10	2	3	3	4	4
	20	11	12	11	26	11	40	11	54	12	9	12	23	12	37	12	51	13	5	20	5	5	5	6	6
	30	11	17	11	31	11	45	12	0	12	14	12	28	12	43	12	57	13	11	30	7	7	8	8	9
	40	11	22	11	36	11	50	12	5	12	19	12	34	12	48	13	2	13	17	40	9	10	10	11	11
	50	11	27	11	41	11	55	12	10	12	24	12	39	12	53	13	8	13	22	50	12	12	13	13	14
24	0	11	32	11	46	12	0	12	15	12	30	12	44	12	59	13	13	13	27	0	0	0	1	1	2
	10	11	36	11	51	12	6	12	20	12	35	12	49	13	4	13	19	13	33	10	2	3	3	4	4
	20	11	41	11	56	12	11	12	25	12	40	12	55	13	10	13	24	13	39	20	5	5	6	6	7
	30	11	46	12	1	12	16	12	30	12	45	13	0	13	15	13	30	13	45	30	7	8	8	9	9
	40	11	51	12	6	12	21	12	36	12	50	13	5	13	20	13	35	13	50	40	10	10	11	11	12
	50	11	56	12	11	12	26	12	41	12	56	13	11	13	26	13	40	13	55	50	12	13	13	14	14
25	0	12	0	12	15	12	31	12	46	13	1	13	16	13	31	13	46	14	1	0	0	0	1	1	2
	10	12	5	12	20	12	36	12	51	13	6	13	21	13	36	13	51	14	7	10	2	3	3	4	4
	20	12	10	12	25	12	41	12	56	13	11	13	26	13	42	13	57	14	12	20	5	5	6	6	7
	30	12	15	12	30	12	46	13	1	13	16	13	32	13	47	14	2	14	17	30	8	8	9	9	10
	40	12	20	12	35	12	50	13	6	13	21	13	37	13	52	14	8	14	23	40	10	11	11	12	12
	50	12	24	12	40	12	55	13	11	13	27	13	42	13	58	14	13	14	29	50	13	13	14	14	15
26	0	12	29	12	45	13	0	13	16	13	32	13	47	14	3	14	18	14	34	0	0	1	1	2	2
	10	12	34	12	50	13	5	13	21	13	37	13	52	14	8	14	24	14	39	10	3	3	4	4	5
	20	12	39	12	55	13	10	13	26	13	42	13	58	14	13	14	29	14	45	20	5	6	6	7	7
	30	12	44	12	59	13	15	13	31	13	47	14	3	14	19	14	35	14	50	30	8	8	9	9	10
	40	12	48	13	4	13	20	13	36	13	52	14	8	14	24	14	40	14	56	40	11	11	12	12	13
	50	12	53	13	9	13	25	13	41	13	57	14	13	14	29	14	45	15	1	50	13	14	14	15	15
27	0	12	58	13	14	13	30	13	46	14	2	14	18	14	35	14	51	15	7	0	0	1	1	2	2
	10	13	2	13	19	13	35	13	51	14	7	14	23	14	40	14	56	15	12	10	3	3	4	4	5
	20	13	7	13	23	13	40	13	56	14	12	14	29	14	45	15	1	15	17	20	5	6	6	7	7
	30	13	12	13	28	13	45	14	1	14	17	14	34	14	50	15	7	15	23	30	8	9	9	10	10
	40	13	17	13	33	13	49	14	6	14	22	14	39	14	55	15	12	15	28	40	11	11	12	13	13
	50	13	21	13	38	13	54	14	11	14	27	14	44	15	1	15	17	15	34	50	14	14	15	15	16
28	0	13	26	13	42	13	59	14	16	14	32	14	49	15	6	15	22	15	39	0	0	1	1	2	2
	10	13	30	13	47	14	4	14	21	14	37	14	54	15	11	15	28	15	45	10	3	3	4	5	5
	20	13	35	13	52	14	9	14	26	14	42	14	59	15	16	15	33	15	50	20	6	6	7	7	8
	30	13	40	13	57	14	14	14	31	14	47	15	4	15	21	15	38	15	55	30	8	9	10	10	11
	40	13	45	14	1	14	18	14	35	14	52	15	9	15	26	15	43	16	1	40	11	12	12	13	13
	50	13	49	14	6	14	23	14	41	14	57	15	15	15	32	15	49	16	6	50	14	15	15	16	16
29	0	13	54	14	11	14	28	14	45	15	2	15	20	15	37	15	54	16	11	0	0	1	1	2	2
	10	13	59	14	16	14	33	14	50	15	7	15	25	15	42	15	59	16	17	10	3	3	4	5	5
	20	14	3	14	20	14	38	14	55	15	12	15	30	15	47	16	4	16	22	20	6	6	7	8	8
	30	14	8	14	25	14	42	15	0	15	17	15	35	15	52	16	10	16	27	30	9	9	10	10	11
	40	14	12	14	30	14	47	15	5	15	22	15	40	15	57	16	15	16	32	40	12	12	13	13	14
	50	14	17	14	35	14	52	15	10	15	27	15	45	16	2	16	20	16	38	50	15	15	16	16	17

Add for Alt. of SUN.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of STAR.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	1″	1″	2″	2″	3″	3″	4″	4″	5″

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.						Add for Minutes of Alt.	
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″		
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″		
30	0	44	6	44	57	45	49	46	41	47	33	48	25	49	17	50	9	51	1	0	0	2	3	5	7	′	″
	10	44	2	44	53	45	45	46	37	47	29	48	21	49	13	50	5	50	57	10	9	10	12	14	16	0	10
	20	43	58	44	49	45	41	46	33	47	25	48	16	49	8	50	0	50	52	20	17	19	21	22	24	1	10
	30	43	54	44	45	45	37	46	29	47	20	48	12	49	4	49	55	50	47	30	26	28	29	31	33	2	9
	40	43	50	44	41	45	33	46	24	47	16	48	7	48	59	49	51	50	42	40	34	36	38	40	41	3	9
	50	43	45	44	37	45	28	46	20	47	11	48	3	48	54	49	46	50	37	50	43	45	47	48	50	4	8
31	0	43	41	44	33	45	24	46	15	47	7	47	58	48	50	49	41	50	33	0	0	2	3	5	7	5	8
	10	43	37	44	28	45	20	46	11	47	2	47	54	48	45	49	36	50	28	10	9	10	12	14	15	6	7
	20	43	33	44	24	45	15	46	7	46	58	47	49	48	40	49	32	50	23	20	17	19	20	22	24	7	7
	30	43	29	44	20	45	11	46	2	46	53	47	44	48	36	49	27	50	18	30	26	27	29	31	32	8	6
	40	43	25	44	15	45	6	45	58	46	49	47	40	48	31	49	22	50	13	40	34	36	38	39	41	9	6
	50	43	20	44	11	45	2	45	53	46	44	47	35	48	26	49	17	50	8	50	43	44	46	48	49		
32	0	43	15	44	7	44	58	45	48	46	39	47	30	48	21	49	12	50	3	0	0	2	3	5	7		
	10	43	11	44	2	44	53	45	44	46	35	47	25	48	16	49	7	49	58	10	8	10	12	13	15	′	″
	20	43	7	43	58	44	48	45	39	46	30	47	21	48	11	49	2	49	53	20	17	18	20	22	23	0	10
	30	43	3	43	53	44	44	45	35	46	25	47	16	48	6	48	57	49	48	30	25	27	28	30	32	1	10
	40	42	58	43	49	44	39	45	30	46	20	47	11	48	1	48	52	49	42	40	33	35	37	38	40	2	9
	50	42	54	43	44	44	35	45	25	46	16	47	6	47	56	48	47	49	37	50	42	43	45	47	48	3	9
33	0	42	50	43	40	44	30	45	20	46	11	47	1	47	51	48	42	49	32	0	0	2	3	5	7	4	8
	10	42	46	43	35	44	25	45	16	46	6	46	56	47	46	48	36	49	27	10	8	10	12	13	15	5	8
	20	42	41	43	30	44	21	45	11	46	1	46	51	47	41	48	31	49	21	20	17	18	20	22	23	6	7
	30	42	36	43	26	44	16	45	6	45	56	46	46	47	36	48	26	49	16	30	25	27	28	30	32	7	7
	40	42	32	43	21	44	11	45	1	45	51	46	41	47	31	48	21	49	11	40	33	35	37	38	40	8	6
	50	42	27	43	16	44	6	44	56	45	46	46	36	47	26	48	16	49	5	50	42	43	45	47	48	9	6
34	0	42	22	43	12	44	2	44	51	45	41	46	31	47	20	48	10	49	0	0	0	2	3	5	7		
	10	42	17	43	7	43	57	44	46	45	36	46	26	47	15	48	5	48	54	10	8	10	11	13	15	′	″
	20	42	12	43	2	43	52	44	41	45	31	46	20	47	10	47	59	48	49	20	16	18	20	21	23	0	10
	30	42	8	42	57	43	47	44	36	45	26	46	15	47	5	47	54	48	44	30	24	26	28	29	31	1	9
	40	42	4	42	53	43	42	44	31	45	21	46	10	46	59	47	49	48	38	40	33	34	36	37	39	2	9
	50	41	59	42	48	43	37	44	26	45	15	46	5	46	54	47	43	48	32	50	41	42	44	46	48	3	8
35	0	41	54	42	43	43	32	44	21	45	10	45	59	46	49	47	38	48	27	0	0	2	3	5	6	4	8
	10	41	49	42	38	43	27	44	16	45	5	45	54	46	43	47	32	48	21	10	8	10	11	13	14	5	7
	20	41	45	42	33	43	22	44	11	45	0	45	49	46	38	47	27	48	16	20	16	18	19	21	23	6	7
	30	41	40	42	28	43	17	44	6	44	55	45	43	46	32	47	21	48	10	30	24	26	27	29	31	7	6
	40	41	35	42	23	43	12	44	0	44	49	45	38	46	27	47	15	48	4	40	32	34	35	37	39	8	6
	50	41	30	42	18	43	7	43	55	44	44	45	33	46	21	47	10	47	58	50	40	42	43	45	47	9	5
36	0	41	25	42	13	43	1	43	50	44	39	45	27	46	16	47	4	47	53	0	0	2	3	5	6	′	″
	10	41	20	42	8	42	56	43	45	44	33	45	22	46	10	46	58	47	47	10	8	10	11	13	14	0	10
	20	41	15	42	3	42	51	43	39	44	28	45	16	46	4	46	53	47	41	20	16	18	19	21	23	1	9
	30	41	10	41	58	42	46	43	34	44	22	45	11	45	59	46	47	47	35	30	24	26	27	29	31	2	9
	40	41	4	41	52	42	41	43	29	44	17	45	5	45	53	46	41	47	29	40	32	34	35	37	39	3	8
	50	40	59	41	47	42	35	43	23	44	11	44	59	45	47	46	35	47	23	50	40	42	43	45	47	4	8
37	0	40	54	41	42	42	30	43	18	44	6	44	54	45	42	46	30	47	18	0	0	2	3	5	6	5	7
	10	40	49	41	37	42	25	43	12	44	0	44	48	45	36	46	24	47	12	10	8	10	11	13	14	6	7
	20	40	44	41	32	42	19	43	7	43	55	44	42	45	30	46	18	47	6	20	16	17	19	21	22	7	6
	30	40	39	41	26	42	14	43	1	43	49	44	37	45	24	46	12	47	0	30	24	25	27	29	30	8	6
	40	40	33	41	21	42	8	42	56	43	43	44	31	45	18	46	6	46	53	40	32	33	35	36	38	9	5
	50	40	28	41	16	42	3	42	50	43	38	44	25	45	13	46	0	46	47	50	40	41	43	44	46		
38	0	40	23	41	10	41	58	42	45	43	32	44	19	45	7	45	54	46	41	0	0	2	3	5	6		
	10	40	17	41	5	41	52	42	39	43	26	44	14	45	1	45	48	46	35	10	8	9	11	12	14	′	″
	20	40	12	41	0	41	47	42	34	43	21	44	8	44	55	45	42	46	29	20	16	17	19	20	22	0	10
	30	40	7	40	54	41	41	42	28	43	15	44	2	44	49	45	36	46	23	30	23	25	27	28	30	1	9
	40	40	2	40	49	41	35	42	22	43	9	43	56	44	43	45	30	46	17	40	31	33	34	36	38	2	9
	50	39	57	40	43	41	30	42	17	43	3	43	50	44	37	45	24	46	10	50	39	41	42	44	45	3	8
39	0	39	52	40	38	41	24	42	11	42	58	43	44	44	31	45	17	46	4	0	0	2	3	5	6	4	8
	10	39	46	40	32	41	19	42	5	42	52	43	38	44	25	45	11	45	58	10	8	9	11	12	14	5	7
	20	39	40	40	27	41	13	41	59	42	46	43	32	44	19	45	5	45	51	20	15	17	19	20	22	6	7
	30	39	35	40	21	41	7	41	54	42	40	43	26	44	12	44	59	45	45	30	23	25	26	28	29	7	6
	40	39	29	40	15	41	2	41	48	42	34	43	20	44	6	44	53	45	39	40	31	32	34	36	37	8	5
	50	39	24	40	10	40	56	41	42	42	28	43	14	44	0	44	46	45	32	50	39	40	42	43	45	9	5

TABLE XXX.*

Auxiliary Arcs.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.									Add for Sec. of Par.					
		53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″
°	′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″
30	0	14 21	14 39	14 57	15 14	15 32	15 50	16 7	16 25	16 43	0	0	1	1	2	2
	10	14 26	14 44	15 1	15 19	15 37	15 55	16 13	16 30	16 48	10	3	4	4	5	5
	20	14 30	14 48	15 6	15 24	15 42	16 0	16 18	16 36	16 53	20	6	7	7	8	8
	30	14 35	14 53	15 11	15 29	15 47	16 5	16 23	16 41	16 59	30	9	10	10	11	11
	40	14 40	14 58	15 16	15 34	15 52	16 10	16 28	16 46	17 4	40	12	13	13	14	14
	50	14 44	15 2	15 20	15 39	15 57	16 15	16 33	16 51	17 9	50	15	16	16	17	17
31	0	14 49	15 7	15 25	15 43	16 2	16 20	16 38	16 56	17 14	0	0	1	1	2	2
	10	14 53	15 11	15 30	15 48	16 7	16 25	16 43	17 1	17 19	10	3	4	4	5	6
	20	14 58	15 16	15 34	15 53	16 11	16 30	16 48	17 6	17 25	20	6	7	7	8	9
	30	15 2	15 21	15 39	15 58	16 16	16 35	16 53	17 11	17 30	30	9	10	10	11	12
	40	15 6	15 25	15 44	16 2	16 21	16 40	16 58	17 16	17 35	40	12	13	14	14	15
	50	15 11	15 30	15 49	16 7	16 26	16 45	17 3	17 22	17 40	50	15	16	17	17	18
32	0	15 16	15 35	15 53	16 12	16 31	16 49	17 8	17 27	17 45	0	0	1	1	2	3
	10	15 20	15 39	15 58	16 17	16 36	16 54	17 13	17 32	17 51	10	3	4	4	5	6
	20	15 25	15 44	16 2	16 21	16 40	16 59	17 18	17 37	17 56	20	6	7	8	8	9
	30	15 29	15 48	16 7	16 26	16 45	17 4	17 23	17 42	18 1	30	9	10	11	11	12
	40	15 34	15 53	16 12	16 31	16 50	17 9	17 28	17 47	18 6	40	13	13	14	15	15
	50	15 38	15 57	16 16	16 36	16 55	17 14	17 33	17 52	18 11	50	16	16	17	18	18
33	0	15 43	16 2	16 21	16 40	16 59	17 19	17 38	17 57	18 16	0	0	1	1	2	3
	10	15 48	16 7	16 26	16 45	17 4	17 24	17 43	18 2	18 21	10	3	4	5	5	6
	20	15 52	16 11	16 30	16 50	17 9	17 28	17 48	18 7	18 26	20	6	7	8	8	9
	30	15 56	16 15	16 35	16 54	17 14	17 33	17 53	18 12	18 31	30	10	10	11	12	12
	40	16 0	16 20	16 39	16 59	17 18	17 38	17 57	18 17	18 36	40	13	14	14	15	15
	59	16 5	16 24	16 44	17 3	17 23	17 43	18 2	18 22	18 41	50	16	17	17	18	19
34	0	16 9	16 29	16 48	17 8	17 28	17 47	18 7	18 27	18 46	0	0	1	1	2	3
	10	16 13	16 33	16 53	17 13	17 32	17 52	18 12	18 32	18 51	10	3	4	5	5	6
	20	16 18	16 37	16 57	17 17	17 37	17 57	18 17	18 37	18 57	20	7	7	8	9	9
	30	16 22	16 42	17 2	17 22	17 42	18 2	18 22	18 42	19 2	30	10	11	11	12	13
	40	16 26	16 46	17 6	17 26	17 47	18 7	18 27	18 47	19 7	40	13	14	15	15	16
	50	16 31	16 51	17 11	17 31	17 51	18 11	18 32	18 52	19 12	50	17	17	18	19	19
35	0	16 35	16 55	17 15	17 36	17 56	18 16	18 36	18 56	19 17	0	0	1	1	2	3
	10	16 39	17 0	17 20	17 40	18 0	18 21	18 41	19 1	19 22	10	3	4	5	5	6
	20	16 44	17 4	17 24	17 45	18 5	18 26	18 46	19 6	19 27	20	7	7	8	9	10
	30	16 48	17 8	17 29	17 49	18 10	18 30	18 51	19 11	19 32	30	10	11	12	12	13
	40	16 52	17 13	17 33	17 54	18 14	18 35	18 55	19 16	19 37	40	14	14	15	16	16
	50	16 57	17 17	17 38	17 58	18 19	18 40	19 0	19 21	19 41	50	17	18	18	19	20
36	0	17 1	17 22	17 42	18 3	18 24	18 44	19 5	19 26	19 46	0	0	1	1	2	3
	10	17 5	17 26	17 47	18 7	18 28	18 49	19 10	19 30	19 51	10	4	4	5	6	6
	20	17 9	17 30	17 51	18 12	18 33	18 53	19 14	19 35	19 56	20	7	8	8	9	10
	30	17 13	17 34	17 55	18 16	18 37	18 58	19 19	19 40	20 1	30	11	11	12	13	13
	40	17 18	17 39	18 0	18 21	18 42	19 3	19 24	19 45	20 6	40	14	15	15	16	17
	50	17 22	17 43	18 4	18 25	18 46	19 8	19 29	19 50	20 11	50	18	18	19	20	20
37	0	17 26	17 47	18 9	18 30	18 51	19 12	19 33	19 54	20 15	0	0	1	1	2	3
	10	17 31	17 52	18 13	18 34	18 55	19 17	19 38	19 59	20 20	10	4	4	5	6	6
	20	17 35	17 56	18 17	18 39	19 0	19 21	19 42	20 4	20 25	20	7	8	9	9	10
	30	17 39	18 0	18 22	18 43	19 5	19 26	19 47	20 9	20 30	30	11	11	12	13	13
	40	17 43	18 4	18 26	18 47	19 9	19 31	19 52	20 13	20 35	40	14	15	16	16	17
	50	17 47	18 9	18 30	18 52	19 14	19 35	19 57	20 18	20 40	50	18	19	19	20	21
38	0	17 51	18 13	18 35	18 56	19 18	19 39	20 1	20 23	20 44	0	0	1	1	2	3
	10	17 55	18 17	18 39	19 1	19 22	19 44	20 6	20 27	20 49	10	4	4	5	6	7
	20	18 0	18 21	18 43	19 5	19 27	19 49	20 10	20 32	20 54	20	7	8	9	9	10
	30	18 4	18 26	18 48	19 9	19 31	19 53	20 15	20 37	20 59	30	11	12	12	13	14
	40	18 8	18 30	18 52	19 14	19 36	19 58	20 20	20 42	21 4	40	15	15	16	17	17
	50	18 12	18 34	18 56	19 18	19 40	20 2	20 24	20 46	21 8	59	18	19	20	20	21
39	0	18 16	18 38	19 0	19 22	19 44	20 7	20 29	20 51	21 13	0	0	1	1	2	3
	10	18 20	18 43	19 5	19 27	19 49	20 11	20 33	20 55	21 18	10	4	4	5	6	7
	20	18 24	18 47	19 9	19 31	19 54	20 16	20 38	21 0	21 22	20	7	8	9	10	10
	30	18 28	18 51	19 13	19 35	19 58	20 20	20 43	21 5	21 27	30	11	12	13	13	14
	40	18 33	18 55	19 17	19 40	20 2	20 25	20 47	21 9	21 32	40	15	16	16	17	18
	50	18 37	18 59	19 22	19 44	20 7	20 29	20 51	21 14	21 36	50	19	19	20	21	22

Add for Alt. of Sun.	
°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.	
°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	0″	1″	1″	2″	2″	3″	3″	4″	4″

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.						Add for Minutes of Alt.	
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″		
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″		
40	0	39	18	40	4	40	50	41	36	42	22	43	8	43	54	44	40	45	26	0	0	1	3	5	6	′	″
	10	39	12	39	58	40	44	41	30	42	16	43	2	43	48	44	34	45	19	10	8	9	11	12	14	0	10
	20	39	7	39	53	40	39	41	24	42	10	42	56	43	41	44	27	45	13	20	15	17	18	20	21	1	9
	30	39	1	39	47	40	33	41	18	42	4	42	50	43	35	44	21	45	7	30	23	24	26	27	29	2	9
	40	38	56	39	41	40	27	41	12	41	58	42	43	43	29	44	14	45	0	40	30	32	33	35	36	3	8
	50	38	51	39	36	40	21	41	6	41	52	42	37	43	23	44	8	44	53	50	38	40	41	43	44	4	8
41	0	38	45	39	30	40	15	41	0	41	46	42	31	43	16	44	1	44	47	0	0	1	3	4	6	5	7
	10	38	39	39	24	40	9	40	54	41	40	42	25	43	10	43	55	44	40	10	7	9	10	12	13	6	6
	20	38	34	39	18	40	3	40	48	41	33	42	18	43	3	43	48	44	33	20	15	16	18	19	21	7	6
	30	38	28	39	12	39	57	40	42	41	27	42	12	42	57	43	42	44	27	30	22	24	25	27	28	8	5
	40	38	22	39	6	39	51	40	36	41	21	42	6	42	50	43	35	44	20	40	30	31	33	34	36	9	5
	50	38	16	39	1	39	45	40	30	41	15	41	59	42	44	43	29	44	13	50	37	39	40	42	43		
42	0	38	10	38	55	39	39	40	24	41	8	41	53	42	38	43	22	44	7	0	0	1	3	4	6		
	10	38	4	38	49	39	33	40	18	41	2	41	46	42	31	43	15	44	0	10	7	9	10	12	13	′	″
	20	37	59	38	43	39	27	40	11	40	56	41	40	42	24	43	9	43	53	20	15	16	18	19	21	0	10
	30	37	53	38	37	39	21	40	5	40	49	41	34	42	18	43	2	43	46	30	22	24	25	27	28	1	9
	40	37	47	38	31	39	15	39	59	40	43	41	27	42	11	42	55	43	39	40	29	31	32	34	35	2	9
	50	37	41	38	25	39	9	39	53	40	37	41	21	42	5	42	49	43	33	50	37	38	40	41	43	3	8
43	0	37	35	38	19	39	2	39	46	40	30	41	14	41	58	42	42	43	26	0	0	1	3	4	6	4	8
	10	37	29	38	12	38	56	39	40	40	24	41	7	41	51	42	35	43	19	10	7	9	10	12	13	5	7
	20	37	23	38	6	38	50	39	34	40	17	41	1	41	45	42	28	43	12	20	15	16	17	19	20	6	6
	30	37	17	38	0	38	44	39	27	40	11	40	54	41	38	42	21	43	5	30	22	23	25	26	28	7	6
	40	37	11	37	54	38	37	39	21	40	4	40	48	41	31	42	14	42	58	40	29	30	32	33	35	8	5
	50	37	5	37	48	38	31	39	14	39	58	40	41	41	24	42	8	42	51	50	36	38	39	41	42	9	4
44	0	36	58	37	42	38	25	39	8	39	51	40	34	41	17	42	1	42	44	0	0	1	3	4	6		
	10	36	52	37	35	38	18	39	1	39	44	40	27	41	10	41	54	42	37	10	7	9	10	11	13	′	″
	20	36	46	37	29	38	12	38	55	39	38	40	21	41	4	41	47	42	30	20	14	16	17	19	20	0	10
	30	36	40	37	23	38	6	38	49	39	31	40	14	40	57	41	40	42	23	30	21	23	24	26	27	1	9
	40	36	35	37	17	37	59	38	42	39	25	40	7	40	50	41	33	42	15	40	29	30	31	33	34	2	9
	50	36	29	37	10	37	53	38	36	39	18	40	1	40	43	41	26	42	8	50	36	37	39	40	41	3	8
45	0	36	22	37	4	37	46	38	29	39	11	39	54	40	36	41	19	42	1	0	0	1	3	4	6	4	8
	10	36	15	36	58	37	40	38	22	39	5	39	47	40	29	41	12	41	54	10	7	8	10	11	13	5	7
	20	36	9	36	51	37	34	38	16	38	58	39	40	40	22	41	4	41	47	20	14	15	17	18	20	6	6
	30	36	3	36	45	37	27	38	9	38	51	39	33	40	15	40	57	41	39	30	21	22	24	25	27	7	6
	40	35	56	36	39	37	21	38	2	38	44	39	26	40	8	40	50	41	32	40	28	29	31	32	34	8	5
	50	35	50	36	32	37	14	37	56	38	38	39	19	40	1	40	43	41	25	50	35	36	38	39	41	9	4
46	0	35	44	36	26	37	7	37	49	38	31	39	12	39	54	40	36	41	17	0	0	1	3	4	6		
	10	35	37	36	19	37	1	37	42	38	24	39	5	39	47	40	29	41	10	10	7	8	10	11	12	′	″
	20	35	31	36	13	36	54	37	36	38	17	38	58	39	40	40	21	41	3	20	14	15	17	18	19	0	10
	30	35	25	36	6	36	48	37	29	38	10	38	51	39	33	40	14	40	55	30	21	22	23	25	26	1	9
	40	35	18	35	59	36	41	37	22	38	3	38	44	39	26	40	7	40	48	40	28	29	30	32	33	2	9
	50	35	12	35	53	36	34	37	15	37	56	38	37	39	18	39	59	40	40	50	34	36	37	39	40	3	8
47	0	35	6	35	47	36	28	37	9	37	49	38	30	39	11	39	52	40	33	0	0	1	3	4	5	4	7
	10	34	59	35	40	36	21	37	2	37	42	38	23	39	4	39	45	40	26	10	7	8	9	11	12	5	6
	20	34	53	35	33	36	14	36	55	37	35	38	16	38	57	39	37	40	18	20	14	15	16	18	19	6	6
	30	34	46	35	27	36	7	36	48	37	28	38	9	38	49	39	30	40	10	30	20	22	23	24	26	7	5
	40	34	40	35	20	36	0	36	41	37	21	38	2	38	42	39	23	40	3	40	27	28	30	31	32	8	4
	50	34	34	35	13	35	53	36	34	37	14	37	55	38	35	39	15	39	55	50	34	35	37	38	39	9	4
48	0	34	27	35	7	35	47	36	27	37	7	37	47	38	27	39	8	39	48	0	0	1	3	4	5		
	10	34	20	35	0	35	40	36	20	37	0	37	40	38	20	39	0	39	40	10	7	8	9	11	12	′	″
	20	34	14	34	53	35	33	36	13	36	53	37	33	38	13	38	53	39	32	20	13	15	16	17	19	0	10
	30	34	7	34	46	35	26	36	6	36	47	37	26	38	5	38	45	39	25	30	20	21	23	24	25	1	9
	40	34	0	34	40	35	19	35	59	36	39	37	18	37	58	38	37	39	17	40	27	28	29	30	32	2	9
	50	33	54	34	33	35	12	35	52	36	31	37	11	37	50	38	30	39	9	50	33	34	36	37	38	3	8
49	0	33	47	34	26	35	5	35	45	36	24	37	4	37	43	38	22	39	2	0	0	1	3	4	5	4	7
	10	33	40	34	19	34	59	35	38	36	17	36	56	37	35	38	15	38	54	10	6	8	9	10	12	5	6
	20	33	33	34	12	34	52	35	31	36	10	36	49	37	28	38	7	38	46	20	13	14	16	17	18	6	6
	30	33	26	34	6	34	45	35	24	36	2	36	41	37	20	37	59	38	38	30	19	21	22	23	25	7	5
	40	33	19	33	59	34	38	35	16	35	55	36	34	37	13	37	52	38	31	40	26	27	29	30	31	8	4
	50	33	13	33	52	34	30	35	9	35	48	36	27	37	5	37	44	38	23	50	32	34	35	36	38	9	4

TABLE XXX.*

Auxiliary Arcs.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″
40	0	18	41	19	3	19	26	19	48	20	11	20	33	20	56	21	18	21	41	0	0	1	2	2	3
	10	18	45	19	8	19	30	19	53	20	15	20	38	21	0	21	23	21	45	10	4	5	5	6	7
	20	18	49	19	12	19	34	19	57	20	20	20	42	21	5	21	28	21	50	20	8	8	9	10	11
	30	18	53	19	16	19	38	20	1	20	24	20	47	21	9	21	32	21	55	30	11	12	13	14	14
	40	18	57	19	20	19	42	20	5	20	28	20	51	21	14	21	37	22	0	40	15	16	17	17	18
	50	19	1	19	24	19	47	20	9	20	32	20	55	21	18	21	41	22	4	50	19	20	20	21	22
41	0	19	5	19	28	19	51	20	14	20	37	21	0	21	23	21	46	22	9	0	0	1	2	2	3
	10	19	9	19	32	19	55	20	18	20	41	21	4	21	27	21	50	22	13	10	4	5	5	6	7
	20	19	13	19	36	19	59	20	22	20	45	21	8	21	31	21	55	22	18	20	8	8	9	10	11
	30	19	17	19	40	20	3	20	26	20	50	21	13	21	36	21	59	22	22	30	12	12	13	14	15
	40	19	21	19	44	20	7	20	31	20	54	21	17	21	40	22	4	22	27	40	15	16	17	18	18
	50	19	25	19	48	20	11	20	35	20	58	21	21	21	45	22	8	22	31	50	19	20	21	22	22
42	0	19	29	19	52	20	15	20	39	21	2	21	26	21	49	22	13	22	36	0	0	1	2	2	3
	10	19	32	19	56	20	20	20	43	21	7	21	30	21	53	22	17	22	40	10	4	5	6	6	7
	20	19	36	20	0	20	24	20	47	21	11	21	34	21	58	22	21	22	45	20	8	9	9	10	11
	30	19	40	20	4	20	28	20	51	21	15	21	38	22	2	22	26	22	49	30	12	13	13	14	15
	40	19	44	20	8	20	32	20	55	21	19	21	43	22	6	22	30	22	54	40	16	17	17	18	19
	50	19	48	20	12	20	36	20	59	21	23	21	47	22	11	22	34	22	58	50	20	20	21	22	23
43	0	19	52	20	16	20	40	21	3	21	27	21	51	22	15	22	39	23	3	0	0	1	2	2	3
	10	19	56	20	20	20	44	21	7	21	31	21	55	22	19	22	43	23	7	10	4	5	6	6	7
	20	20	0	20	24	20	48	21	11	21	35	21	59	22	23	22	47	23	11	20	8	9	10	10	11
	30	20	3	20	27	20	51	21	15	21	39	22	4	22	28	22	52	23	16	30	12	13	14	14	15
	40	20	7	20	31	20	55	21	20	21	41	22	8	22	32	22	56	23	20	40	16	17	18	18	19
	50	20	11	20	35	21	0	21	24	21	48	22	12	22	36	23	0	23	25	50	20	21	22	22	23
44	0	20	15	20	39	21	3	21	28	21	52	22	16	22	41	23	5	23	29	0	0	1	2	2	3
	10	20	19	20	43	21	7	21	32	21	56	22	20	22	45	23	9	23	33	10	4	5	6	6	7
	20	20	22	20	47	21	11	21	36	22	0	22	24	22	49	23	13	23	38	20	8	9	10	11	11
	30	20	26	20	51	21	15	21	40	22	4	22	28	22	53	23	18	23	42	30	12	13	14	15	16
	40	20	30	20	54	21	19	21	44	22	8	22	33	22	57	23	22	23	46	40	16	17	18	19	20
	50	20	34	20	58	21	23	21	47	22	12	22	37	23	1	23	26	23	50	50	20	21	22	23	24
45	0	20	37	21	2	21	27	21	51	22	16	22	41	23	5	23	30	23	55	0	0	1	2	2	3
	10	20	41	21	6	21	31	21	55	22	20	22	45	23	10	23	34	23	59	10	4	5	6	7	7
	20	20	45	21	10	21	34	21	59	22	24	22	49	23	14	23	39	24	3	20	8	9	10	11	12
	30	20	48	21	13	21	38	22	3	22	28	22	53	23	18	23	43	24	8	30	12	13	14	15	16
	40	20	52	21	17	21	42	22	7	22	32	22	57	23	22	23	47	24	12	40	17	17	18	19	20
	50	20	56	21	21	21	46	22	11	22	36	23	1	23	26	23	51	24	16	50	21	22	22	23	24
46	0	21	0	21	25	21	50	22	15	22	40	23	5	23	30	23	55	24	20	0	0	1	2	3	3
	10	21	3	21	28	21	54	22	19	22	44	23	9	23	34	23	59	24	25	10	4	5	6	7	8
	20	21	7	21	32	21	57	22	23	22	48	23	13	23	38	24	3	24	29	20	8	9	10	11	12
	30	21	10	21	36	22	1	22	26	22	52	23	17	23	42	24	8	24	33	30	13	14	14	15	16
	40	21	14	21	40	22	5	22	30	22	56	23	21	23	46	24	12	24	37	40	17	18	19	19	20
	50	21	18	21	43	22	8	22	34	22	59	23	25	23	50	24	16	24	41	50	21	22	23	24	25
47	0	21	21	21	47	22	12	22	38	23	3	23	29	23	54	24	20	24	45	0	0	1	2	3	3
	10	21	25	21	50	22	16	22	42	23	7	23	33	23	58	24	24	24	49	10	4	5	6	7	8
	20	21	28	21	54	22	20	22	45	23	11	23	37	24	2	24	28	24	54	20	9	9	10	11	12
	30	21	32	21	58	22	23	22	49	23	15	23	41	24	6	24	32	24	58	30	13	14	15	15	16
	40	21	35	22	1	22	27	22	53	23	19	23	44	24	10	24	36	25	2	40	17	18	19	20	21
	50	21	39	22	5	22	31	22	57	23	22	23	48	24	14	24	40	25	6	50	22	22	23	24	25
48	0	21	43	22	8	22	34	23	0	23	26	23	52	24	18	24	44	25	10	0	0	1	2	3	3
	10	21	46	22	12	22	38	23	4	23	30	23	56	24	22	24	48	25	14	10	4	5	6	7	8
	20	21	50	22	16	22	42	23	8	23	34	24	0	24	26	24	52	25	18	20	9	10	10	11	12
	30	21	53	22	19	22	45	23	11	23	38	24	4	24	30	24	56	25	22	30	13	14	15	16	17
	40	21	57	22	23	22	49	23	15	23	41	24	7	24	34	25	0	25	26	40	17	18	19	20	21
	50	22	0	22	26	22	52	23	19	23	45	24	11	24	37	25	4	25	30	50	22	23	23	24	25
49	0	22	4	22	30	22	56	23	22	23	49	24	15	24	41	25	8	25	34	0	0	1	2	3	4
	10	22	7	22	33	23	0	23	26	23	52	24	19	24	45	25	11	25	38	10	4	5	6	7	8
	20	22	11	22	37	23	3	23	30	23	56	24	23	24	49	25	15	25	42	20	9	10	11	11	12
	30	22	14	22	40	23	7	23	34	24	0	24	26	24	53	25	19	25	46	30	13	14	15	16	17
	40	22	17	22	44	23	11	23	37	24	3	24	30	24	57	25	23	25	50	40	18	19	19	20	21
	50	22	21	22	47	23	14	23	41	24	7	24	34	25	0	25	27	25	54	50	22	23	24	25	26

Add for Alt. of Sun.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	0″	1″	1″	2″	2″	2″	3″	3″	4″

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.						Add for Minutes of Alt.	
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″		
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″		
50	0	33	6	33	45	34	23	35	2	35	41	36	19	36	58	37	36	38	15	0	0	1	3	4	5	′	″
	10	32	59	33	38	34	16	34	55	35	33	36	12	36	50	37	29	38	7	10	6	8	9	10	11	0	10
	20	32	53	33	31	34	9	34	48	35	26	36	4	36	42	37	21	37	59	20	13	14	15	17	18	1	9
	30	32	46	33	24	34	2	34	40	35	18	35	57	36	35	37	13	37	51	30	19	20	22	23	24	2	9
	40	32	39	33	17	33	55	34	33	35	11	35	49	36	27	37	5	37	43	40	25	27	28	29	31	3	8
	50	32	32	33	10	33	48	34	26	35	4	35	42	36	19	36	57	37	35	50	32	33	34	36	37	4	7
51	0	32	25	33	3	33	41	34	18	34	56	35	34	36	12	36	49	37	27	0	0	1	2	4	5	5	6
	10	32	18	32	56	33	33	34	11	34	49	35	26	36	4	36	42	37	19	10	6	7	9	10	11	6	6
	20	32	11	32	49	33	26	34	4	34	41	35	19	35	56	36	34	37	11	20	12	14	15	16	17	7	5
	30	32	4	32	42	33	19	33	56	34	34	35	11	35	49	36	26	37	3	30	19	20	21	22	24	8	4
	40	31	57	32	35	33	12	33	49	34	26	35	3	35	41	36	18	36	55	40	25	26	28	29	30	9	3
	50	31	50	32	27	33	4	33	42	34	19	34	56	35	33	36	10	36	47	50	31	32	34	35	36		
52	0	31	43	32	20	32	57	33	34	34	11	34	48	35	25	36	2	36	39	0	0	1	2	4	5		
	10	31	36	32	13	32	50	33	27	34	3	34	40	35	17	35	54	36	31	10	6	7	9	10	11	′	″
	20	31	29	32	6	32	43	33	19	33	56	34	33	35	9	35	46	36	23	20	12	13	15	16	17	0	10
	30	31	22	31	59	32	35	33	12	33	48	34	25	35	1	35	38	36	14	30	18	19	21	22	23	1	9
	40	31	15	31	51	32	28	33	4	33	41	34	17	34	53	35	30	36	6	40	24	26	27	28	29	2	8
	50	31	8	31	44	32	20	32	57	33	33	34	9	34	45	35	22	35	58	50	30	32	33	34	35	3	8
53	0	31	1	31	37	32	13	32	49	33	25	34	1	34	38	35	14	35	50	0	0	1	2	4	5	4	7
	10	30	53	31	30	32	6	32	42	33	18	33	54	34	30	35	5	35	41	10	6	7	8	10	11	5	6
	20	30	46	31	22	31	58	32	34	33	10	33	46	34	22	34	57	35	33	20	12	13	14	15	17	6	5
	30	30	39	31	15	31	51	32	26	33	2	33	38	34	14	34	49	35	25	30	18	19	20	21	23	7	5
	40	30	32	31	8	31	43	32	19	32	54	33	30	34	5	34	41	35	17	40	24	25	26	27	29	8	4
	50	30	25	31	0	31	36	32	11	32	47	33	22	33	57	34	33	35	8	50	30	31	32	33	35	9	3
54	0	30	18	30	53	31	28	32	3	32	39	33	14	33	49	34	25	35	0	0	0	1	2	3	5		
	10	30	11	30	46	31	21	31	56	32	31	33	6	33	41	34	16	34	52	10	6	7	8	9	10	′	″
	20	30	3	30	38	31	13	31	48	32	23	32	58	33	33	34	8	34	43	20	12	13	14	15	16	0	10
	30	29	56	30	31	31	6	31	41	32	15	32	50	33	25	34	0	34	35	30	17	19	20	21	22	1	9
	40	29	49	30	23	30	58	31	33	32	8	32	42	33	17	33	52	34	26	40	23	24	26	27	28	2	8
	50	29	42	30	16	30	51	31	25	32	0	32	34	33	9	33	43	34	18	50	29	30	31	32	34	3	8
55	0	29	34	30	9	30	43	31	17	31	52	32	26	33	1	33	35	34	9	0	0	1	2	3	5	4	7
	10	29	26	30	1	30	35	31	10	31	44	32	18	32	52	33	27	34	1	10	6	7	8	9	10	5	6
	20	29	19	29	54	30	28	31	2	31	36	32	10	32	44	33	18	33	52	20	11	12	14	15	16	6	5
	30	29	11	29	46	30	20	30	54	31	28	32	2	32	36	33	10	33	44	30	17	18	19	20	22	7	4
	40	29	4	29	38	30	12	30	46	31	20	31	54	32	27	33	2	33	35	40	23	24	25	26	27	8	4
	50	28	57	29	31	30	5	30	38	31	12	31	46	32	19	32	53	33	27	50	28	29	31	32	33	9	3
56	0	28	50	29	23	29	57	30	30	31	4	31	38	32	11	32	45	33	18	0	0	1	2	3	4		
	10	28	43	29	16	29	49	30	23	30	56	31	29	32	3	32	36	33	10	10	6	7	8	9	10	′	″
	20	28	35	29	8	29	41	30	15	30	48	31	21	31	54	32	28	33	1	20	11	12	13	14	15	0	10
	30	28	27	29	1	29	34	30	7	30	40	31	13	31	46	32	19	32	52	30	17	18	19	20	21	1	9
	40	28	20	28	53	29	26	29	59	30	32	31	5	31	38	32	11	32	44	40	22	23	24	25	26	2	8
	50	28	13	28	45	29	18	29	51	30	24	30	57	31	29	32	2	32	35	50	28	29	30	31	32	3	8
57	0	28	5	28	38	29	10	29	43	30	16	30	48	31	21	31	54	32	26	0	0	1	2	3	4	4	7
	10	27	57	28	30	29	2	29	35	30	8	30	40	31	13	31	45	32	18	10	5	6	8	9	10	5	6
	20	27	50	28	22	28	55	29	27	29	59	30	32	31	4	31	37	32	9	20	11	12	13	14	15	6	5
	30	27	43	28	15	28	47	29	19	29	51	30	24	30	56	31	28	32	0	30	16	17	18	19	20	7	4
	40	27	35	28	7	28	39	29	11	29	43	30	15	30	47	31	19	31	51	40	21	23	24	25	26	8	4
	50	27	28	27	59	28	31	29	3	29	35	30	7	30	39	31	11	31	43	50	27	28	29	30	31	9	3
58	0	27	20	27	51	28	23	28	55	29	27	29	59	30	30	31	2	31	34	0	0	1	2	3	4		
	10	27	12	27	44	28	15	28	47	29	19	29	50	30	22	30	53	31	25	10	5	6	7	8	9	′	″
	20	27	4	27	36	28	7	28	39	29	10	29	42	30	13	30	45	31	16	20	10	11	13	14	15	0	10
	30	26	57	27	28	27	59	28	31	29	2	29	33	30	5	30	36	31	7	30	16	17	18	19	20	1	9
	40	26	50	27	20	27	51	28	23	28	54	29	25	29	56	30	27	30	59	40	21	22	23	24	25	2	8
	50	26	42	27	12	27	43	28	14	28	45	29	17	29	48	30	19	30	50	50	26	27	28	29	30	3	8
59	0	26	34	27	5	27	35	28	6	28	37	29	8	29	39	30	10	30	41	0	0	1	2	3	4	4	7
	10	26	26	26	57	27	27	27	58	28	29	29	0	29	30	30	1	30	32	10	5	6	7	8	9	5	6
	20	26	18	26	49	27	19	27	50	28	21	28	51	29	22	29	52	30	23	20	10	11	12	13	14	6	5
	30	26	10	26	41	27	11	27	42	28	12	28	43	29	13	29	44	30	14	30	15	16	17	18	19	7	4
	40	26	3	26	33	27	3	27	31	28	4	28	31	29	4	29	35	30	5	40	20	21	22	23	24	8	3
	50	25	55	26	25	26	55	27	25	27	56	28	26	28	56	29	26	29	56	50	25	26	27	28	29	9	3

TABLE XXX.*

Auxiliary Arcs.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″
50	0	22	24	22	51	23	18	23	44	24	11	24	37	25	4	25	31	25	58	0	0	1	2	3	4
	10	22	28	22	54	23	21	23	48	24	15	24	41	25	8	25	35	26	1	10	4	5	6	7	8
	20	22	31	22	58	23	25	23	51	24	18	24	45	25	11	25	38	26	5	20	9	10	11	12	13
	30	22	34	23	1	23	28	23	55	24	22	24	49	25	15	25	42	26	9	30	13	14	15	16	17
	40	22	38	23	5	23	31	23	58	24	25	24	52	25	19	25	46	26	13	40	18	19	20	21	22
	50	22	41	23	8	23	35	24	2	24	29	24	56	25	23	25	50	26	17	50	22	23	24	25	26
51	0	22	44	23	11	23	38	24	5	24	32	25	0	25	27	25	54	26	21	0	0	1	2	3	4
	10	22	47	23	15	23	42	24	9	24	36	25	3	25	30	25	57	26	24	10	5	5	6	7	8
	20	22	51	23	18	23	45	24	12	24	40	25	7	25	34	26	1	26	28	20	9	10	11	12	13
	30	22	54	23	21	23	49	24	16	24	43	25	10	25	38	26	5	26	32	30	14	15	15	16	17
	40	22	57	23	25	23	52	24	19	24	47	25	14	25	41	26	8	26	35	40	18	19	20	21	22
	50	23	1	23	28	23	55	24	23	24	50	25	17	25	45	26	12	26	39	50	23	24	25	25	26
52	0	23	4	23	31	23	59	24	26	24	54	25	21	25	48	26	16	26	43	0	0	1	2	3	4
	10	23	7	23	35	24	2	24	30	24	57	25	24	25	52	26	19	26	47	10	5	6	6	7	8
	20	23	10	23	38	24	5	24	33	25	0	25	28	25	55	26	23	26	50	20	9	10	11	12	13
	30	23	14	23	41	24	9	24	36	25	4	25	31	25	59	26	27	26	54	30	14	15	16	17	17
	40	23	17	23	44	24	12	24	40	25	7	25	35	26	3	26	30	26	58	40	18	19	20	21	22
	50	23	20	23	48	24	15	24	43	25	11	25	38	26	6	26	34	27	1	50	23	24	25	26	27
53	0	23	23	23	51	24	19	24	46	25	14	25	42	26	10	26	37	27	5	0	0	1	2	3	4
	10	23	26	23	54	24	22	24	50	25	18	25	45	26	13	26	41	27	8	10	5	6	7	7	8
	20	23	29	23	57	24	25	24	53	25	21	25	49	26	17	26	44	27	12	20	9	10	11	12	13
	30	23	32	24	0	24	28	24	56	25	24	25	52	26	20	26	48	27	16	30	14	15	16	17	18
	40	23	36	24	4	24	32	25	0	25	28	25	56	26	24	26	52	27	19	40	19	20	21	21	22
	50	23	39	24	7	24	35	25	3	25	31	25	59	26	27	26	55	27	23	50	23	24	25	26	27
54	0	23	42	24	10	24	38	25	6	25	34	26	2	26	30	26	59	27	27	0	0	1	2	3	4
	10	23	45	24	13	24	41	25	10	25	38	26	6	26	34	27	2	27	30	10	5	6	7	8	8
	20	23	48	24	16	24	44	25	13	25	41	26	9	26	37	27	5	27	34	20	9	10	11	12	13
	30	23	51	24	19	24	48	25	16	25	44	26	13	26	41	27	9	27	37	30	14	15	16	17	18
	40	23	54	24	23	24	51	25	19	25	48	26	16	26	44	27	12	27	41	40	19	20	21	22	23
	50	23	57	24	26	24	54	25	22	25	51	26	19	26	48	27	16	27	44	50	24	24	25	26	27
55	0	24	0	24	29	24	57	25	25	25	54	26	22	26	51	27	19	27	48	0	0	1	2	3	4
	10	24	3	24	32	25	0	25	29	25	57	26	26	26	54	27	23	27	51	10	5	6	7	8	9
	20	24	6	24	35	25	3	25	32	26	0	26	29	26	58	27	26	27	55	20	10	10	11	12	13
	30	24	9	24	38	25	6	25	35	26	4	26	32	27	1	27	29	27	58	30	14	15	16	17	18
	40	24	12	24	41	25	10	25	38	26	7	26	35	27	4	27	33	28	1	40	19	20	21	22	23
	50	24	15	24	44	25	13	25	41	26	10	26	39	27	7	27	36	28	5	50	24	25	26	27	28
56	0	24	18	24	47	25	16	25	44	26	13	26	42	27	11	27	39	28	8	0	0	1	2	3	4
	10	24	21	24	50	25	19	25	48	26	16	26	45	27	14	27	43	28	12	10	5	6	7	8	9
	20	24	24	24	53	25	22	25	51	26	19	26	48	27	17	27	46	28	15	20	10	11	12	12	13
	30	24	27	24	56	25	25	25	54	26	23	26	51	27	20	27	49	28	18	30	14	15	16	17	18
	40	24	30	24	59	25	28	25	57	26	26	26	55	27	24	27	53	28	22	40	19	20	21	22	23
	50	24	33	25	2	25	31	26	0	26	29	26	58	27	27	27	56	28	25	50	24	25	26	27	28
57	0	24	35	25	4	25	34	26	3	26	32	27	1	27	30	27	59	28	28	0	0	1	2	3	4
	10	24	38	25	7	25	36	26	6	26	35	27	4	27	33	28	2	28	31	10	5	6	7	8	9
	20	24	41	25	10	25	39	26	9	26	38	27	7	27	36	28	6	28	35	20	10	11	12	13	14
	30	24	44	25	13	25	42	26	12	26	41	27	10	27	40	28	9	28	38	30	15	16	17	18	19
	40	24	47	25	16	25	45	26	15	26	44	27	13	27	43	28	12	28	41	40	19	20	21	22	23
	50	24	50	25	19	25	48	26	18	26	47	27	16	27	46	28	15	28	44	50	24	25	26	27	28
58	0	24	52	25	22	25	51	26	21	26	50	27	19	27	49	28	18	28	48	0	0	1	2	3	4
	10	24	55	25	25	25	54	26	24	26	53	27	23	27	52	28	21	28	51	10	5	6	7	8	9
	20	24	58	25	28	25	57	26	27	26	56	27	26	27	55	28	25	28	54	20	10	11	12	13	14
	30	25	1	25	30	26	0	26	29	26	59	27	29	27	58	28	28	28	57	30	15	16	17	18	19
	40	25	3	25	33	26	3	26	32	27	2	27	32	28	1	28	31	29	0	40	20	21	22	23	24
	50	25	6	25	36	26	6	26	35	27	5	27	34	28	4	28	34	29	3	50	25	26	27	28	29
59	0	25	9	25	39	26	8	26	38	27	8	27	37	28	7	28	37	29	6	0	0	1	2	3	4
	10	25	11	25	41	26	11	26	41	27	11	27	40	28	10	28	40	29	10	10	5	6	7	8	9
	20	25	14	25	44	26	14	26	44	27	13	27	43	28	13	28	43	29	13	20	10	11	12	13	14
	30	25	17	25	47	26	17	26	47	27	16	27	46	28	16	28	46	29	16	30	15	16	17	18	19
	40	25	20	25	49	26	19	26	49	27	19	27	49	28	19	28	49	29	19	40	20	21	22	23	24
	50	25	22	25	52	26	22	26	52	27	22	27	52	28	22	28	52	29	22	50	25	26	27	28	29

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	0″	1″	1″	1″	2″	2″	2″	3″	3″

Add for Alt. of Sun.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.						Add for Minutes of Alt.	
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″		
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″		
60	0	25	47	26	17	26	47	27	17	27	47	28	17	28	47	29	17	29	47	0	0	1	2	3	4	′	″
	10	25	39	26	9	26	39	27	9	27	39	28	9	28	38	29	8	29	38	10	5	6	7	8	9	0	10
	20	25	31	26	1	26	31	27	1	27	30	28	0	28	30	28	59	29	29	20	10	11	12	13	14	1	9
	30	25	23	25	53	26	23	26	52	27	22	27	51	28	21	28	51	29	20	30	15	16	17	18	19	2	8
	40	25	16	25	45	26	15	26	44	27	13	27	43	28	12	28	42	29	11	40	29	21	22	23	24	3	7
	50	25	8	25	37	26	6	26	36	27	5	27	34	28	3	28	33	29	2	50	25	26	27	28	29	4	7
61	0	25	0	25	29	25	58	26	27	26	56	27	26	27	55	28	24	28	53	0	0	1	2	3	4	5	6
	10	24	52	25	21	25	50	26	19	26	48	27	17	27	46	28	15	28	44	10	5	6	7	8	9	6	5
	20	24	44	25	13	25	42	26	11	26	39	27	8	27	37	28	6	28	35	20	10	10	11	12	13	7	4
	30	24	37	25	5	25	34	26	2	26	31	27	0	27	28	27	57	28	25	30	14	15	16	17	18	8	3
	40	24	29	24	57	25	25	25	54	26	22	26	51	27	19	27	48	28	16	40	19	20	21	22	23	9	2
	50	24	21	24	49	25	17	25	46	26	14	26	42	27	11	27	39	28	7	50	24	25	26	27	28		
62	0	24	13	24	41	25	9	25	37	26	5	26	33	27	2	27	30	27	58	0	0	1	2	3	4		
	10	24	5	24	33	25	1	25	29	25	57	26	25	26	53	27	21	27	49	10	5	6	6	7	8	′	″
	20	23	57	24	25	24	52	25	20	25	48	26	16	26	44	27	12	27	40	20	9	10	11	12	13	0	10
	30	23	49	24	16	24	44	25	12	25	40	26	7	26	35	27	3	27	50	30	14	15	16	17	18	1	9
	40	23	41	24	8	24	36	25	3	25	31	25	58	26	26	26	54	27	21	40	18	19	20	21	22	2	8
	50	23	33	24	0	24	28	24	55	25	22	25	50	26	17	26	44	27	12	50	23	24	25	26	27	3	7
63	0	23	25	23	52	24	19	24	46	25	14	25	41	26	8	26	35	27	3	0	0	1	2	3	4	4	7
	10	23	17	23	44	24	11	24	38	25	5	25	32	25	59	26	26	26	53	10	4	5	6	7	8	5	6
	20	23	8	23	35	24	2	24	29	24	56	25	23	25	50	26	17	26	44	20	9	10	11	12	12	6	5
	30	23	0	23	27	23	54	24	21	24	48	25	14	25	41	26	8	26	35	30	13	14	15	16	17	7	4
	40	22	52	23	19	23	46	24	12	24	39	25	5	25	32	25	59	26	25	40	18	19	20	21	21	8	3
	50	22	44	23	11	23	37	24	4	24	30	24	57	25	23	25	50	26	16	50	22	23	24	25	26	9	2
64	0	22	36	23	3	23	29	23	55	24	21	24	48	25	14	25	40	26	7	0	0	1	2	3	3		
	10	22	28	22	54	23	20	23	47	24	13	24	39	25	5	25	31	25	57	10	4	5	6	7	8	′	″
	20	22	19	22	46	23	12	23	38	24	4	24	30	24	56	25	22	25	48	20	9	9	10	11	12	0	10
	30	22	11	22	38	23	4	23	29	23	55	24	21	24	47	25	13	25	38	30	13	14	15	15	16	1	9
	40	22	3	22	29	22	55	23	21	23	46	24	12	24	38	25	3	25	29	40	17	18	19	20	21	2	8
	50	21	55	22	21	22	47	23	12	23	38	24	3	24	29	24	54	25	20	50	22	22	23	24	25	3	7
65	0	21	47	22	13	22	38	23	3	23	29	23	54	24	20	24	45	25	10	0	0	1	2	2	3	4	7
	10	21	39	22	4	22	30	22	55	23	20	23	45	24	10	24	36	25	1	10	4	5	6	7	7	5	6
	20	21	31	21	56	22	21	22	46	23	11	23	36	24	1	24	26	24	51	20	8	9	10	11	12	6	5
	30	21	23	21	48	22	13	22	37	23	2	23	27	23	52	24	17	24	42	30	12	13	14	15	16	7	4
	40	21	15	21	39	22	4	22	29	22	53	23	18	23	43	24	8	24	33	40	17	17	18	19	20	8	3
	50	21	7	21	31	21	55	22	20	22	45	23	9	23	34	23	58	24	23	50	21	21	22	23	24	9	2
66	0	20	59	21	22	21	47	22	11	22	36	23	0	23	24	23	49	24	13	0	0	1	2	2	3		
	10	20	50	21	14	21	38	22	3	22	27	22	51	23	15	23	40	24	4	10	4	5	6	6	7	′	″
	20	20	41	21	6	21	30	21	54	22	18	22	42	23	6	23	30	23	54	20	8	9	10	10	11	0	10
	30	20	33	20	57	21	21	21	45	22	9	22	33	22	57	23	21	23	45	30	12	13	14	14	15	1	9
	40	20	25	20	49	21	13	21	36	22	0	22	24	22	48	23	11	23	35	40	16	17	18	18	19	2	8
	50	20	17	20	40	21	4	21	27	21	51	22	15	22	38	23	2	23	25	50	20	21	21	22	23	3	7
67	0	20	9	20	32	20	55	21	19	21	42	22	6	22	29	22	52	23	16	0	0	1	2	2	3	4	6
	10	20	0	20	23	20	47	21	10	21	33	21	56	22	20	22	43	23	6	10	4	5	5	6	7	5	6
	20	19	51	20	15	20	38	21	1	21	24	21	47	22	10	22	34	22	57	20	8	8	9	10	11	6	5
	30	19	43	20	6	20	29	20	52	21	15	21	38	22	1	22	24	22	47	30	11	12	13	14	14	7	4
	40	19	35	19	58	20	21	20	43	21	6	21	29	21	52	22	15	22	37	40	15	16	17	18	18	8	3
	50	19	27	19	49	20	12	20	35	20	57	21	20	21	42	22	5	22	28	50	19	20	21	21	22	9	2
68	0	19	18	19	41	20	3	20	26	20	48	21	11	21	33	21	56	22	18	0	0	1	2	2	3		
	10	19	10	19	32	19	54	20	17	20	39	21	1	21	24	21	46	22	8	10	4	4	5	6	7		″
	20	19	1	19	24	19	46	20	8	20	30	20	52	21	14	21	37	21	59	20	7	8	9	10	10	0	10
	30	18	53	19	15	19	37	19	59	20	21	20	43	21	5	21	27	21	49	30	11	12	12	13	14	1	9
	40	18	45	19	6	19	28	19	50	20	12	20	34	20	56	21	17	21	39	40	15	15	16	17	18	2	8
	50	18	36	18	58	19	20	19	41	20	3	20	25	20	46	21	8	21	29	50	18	19	20	20	21	3	7
69	0	18	28	18	49	19	11	19	32	19	54	20	15	20	37	20	58	21	20	0	0	1	1	2	3	4	6
	10	18	19	18	41	19	2	19	23	19	45	20	6	20	27	20	48	21	10	10	4	4	5	6	6	5	5
	20	18	10	18	32	18	53	19	14	19	36	19	57	20	18	20	39	21	0	20	7	8	8	9	10	6	5
	30	18	2	18	23	18	44	19	5	19	26	19	47	20	8	20	29	20	50	30	11	11	12	13	13	7	4
	40	17	54	18	15	18	36	18	56	19	17	19	38	19	59	20	20	20	41	40	14	15	15	16	17	8	3
	50	17	45	18	6	18	27	18	47	19	8	19	29	19	49	20	10	20	31	50	18	18	19	20	20	9	2

TABLE XXX.*

Auxiliary Arcs.—Add 60 degrees to the minutes and seconds taken from the Table

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	′
60	0	25	25	25	55	26	25	26	55	27	25	27	55	28	25	28	55	29	25	0	0	1	2	3	4
	10	25	27	25	57	26	28	26	58	27	28	27	58	28	28	28	58	29	28	10	5	6	7	8	9
	20	25	30	26	0	26	30	27	1	27	31	28	1	28	31	29	1	29	31	20	10	11	12	13	14
	30	25	33	26	3	26	33	27	3	27	33	28	4	28	34	29	4	29	34	30	15	16	17	18	19
	40	25	35	26	5	26	36	27	6	27	36	28	6	28	37	29	7	29	37	40	20	21	22	23	24
	50	25	38	26	8	26	38	27	9	27	39	28	9	28	39	29	10	29	40	50	25	26	27	28	29
61	0	25	40	26	11	26	41	27	11	27	42	28	12	28	42	29	12	29	43	0	0	1	2	3	4
	10	25	43	26	13	26	44	27	14	27	44	28	15	28	45	29	15	29	46	10	5	6	7	8	9
	20	25	45	26	16	26	46	27	17	27	47	28	18	28	48	29	18	29	49	20	10	11	12	13	14
	30	25	48	26	18	26	49	27	19	27	50	28	20	28	51	29	21	29	52	30	15	16	17	18	19
	40	25	51	26	21	26	51	27	22	27	52	28	23	28	53	29	24	29	54	40	20	21	22	23	24
	50	25	53	26	23	26	54	27	25	27	55	28	26	28	56	29	27	29	57	50	25	26	27	28	29
62	0	25	55	26	26	26	57	27	27	27	58	28	28	28	59	29	29	30	0	0	0	1	2	3	4
	10	25	58	26	28	26	59	27	30	28	0	28	31	29	2	29	32	30	3	10	5	6	7	8	9
	20	26	0	26	31	27	2	27	32	28	3	28	34	29	4	29	35	30	6	20	10	11	12	13	14
	30	26	3	26	33	27	4	27	35	28	6	28	36	29	7	29	38	30	8	30	15	16	17	18	19
	40	26	5	26	36	27	7	27	37	28	8	28	39	29	10	29	40	30	11	40	20	21	22	23	24
	50	26	7	26	38	27	9	27	40	28	11	28	42	29	12	29	43	30	14	50	26	27	28	29	30
63	0	26	10	26	41	27	12	27	43	28	13	28	44	29	15	29	46	30	17	0	0	1	2	3	4
	10	26	12	26	43	27	14	27	45	28	16	28	47	29	18	29	49	30	19	10	5	6	7	8	9
	20	26	15	26	46	27	17	27	48	28	19	28	50	29	20	29	51	30	22	20	10	11	12	14	15
	30	26	17	26	48	27	19	27	50	28	21	28	52	29	23	29	54	30	25	30	16	17	18	19	20
	40	26	19	26	50	27	21	27	52	28	23	28	54	29	25	29	56	30	27	40	21	22	23	24	25
	50	26	22	26	53	27	24	27	55	28	26	28	57	29	28	29	59	30	30	50	26	27	28	29	30
64	0	26	24	26	55	27	26	27	57	28	28	28	59	29	31	30	2	30	33	0	0	1	2	3	4
	10	26	26	26	57	27	29	28	0	28	31	29	2	29	33	30	4	30	35	10	5	6	7	8	9
	20	26	28	27	0	27	31	28	2	28	33	29	5	29	36	30	7	30	38	20	10	11	12	14	15
	30	26	31	27	2	27	33	28	5	28	36	29	7	29	38	30	9	30	41	30	16	17	18	19	20
	40	26	33	27	4	27	36	28	7	28	38	29	9	29	41	30	12	30	43	40	21	22	23	24	25
	50	26	35	27	7	27	38	28	9	28	41	29	12	29	43	30	14	30	46	50	26	27	28	29	30
65	0	26	37	27	9	27	40	28	12	28	43	29	14	29	46	30	17	30	48	0	0	1	2	3	4
	10	26	40	27	11	27	43	28	14	28	45	29	17	29	48	30	20	30	51	10	5	6	7	8	9
	20	26	42	27	13	27	45	28	16	28	48	29	19	29	51	30	22	30	53	20	10	12	13	14	15
	30	26	44	27	16	27	47	28	19	28	50	29	22	29	53	30	24	30	56	30	16	17	18	19	20
	40	26	46	27	18	27	49	28	21	28	52	29	24	29	55	30	27	30	58	40	21	22	23	24	25
	50	26	48	27	20	27	52	28	23	28	55	29	26	29	58	30	29	31	1	50	26	27	28	29	30
66	0	26	51	27	22	27	54	28	25	28	57	29	29	30	0	30	32	31	3	0	0	1	2	3	4
	10	26	53	27	24	27	56	28	28	28	59	29	31	30	3	30	34	31	6	10	5	6	7	8	10
	20	26	55	27	27	27	58	28	30	29	2	29	33	30	5	30	36	31	8	20	11	12	13	14	15
	30	26	57	27	29	28	0	28	32	29	4	29	35	30	7	30	39	31	11	30	16	17	18	19	20
	40	26	59	27	31	28	2	28	34	29	6	29	38	30	10	30	41	31	13	40	21	22	23	24	25
	50	27	1	27	33	28	5	28	37	29	8	29	40	30	12	30	44	31	16	50	26	28	29	30	31
67	0	27	3	27	35	28	7	28	39	29	10	29	42	30	14	30	46	31	18	0	0	1	2	3	4
	10	27	5	27	37	28	9	28	41	29	13	29	45	30	16	30	48	31	20	10	5	6	7	9	10
	20	27	7	27	39	28	11	28	43	29	15	29	47	30	19	30	50	31	22	20	11	12	13	14	15
	30	27	9	27	41	28	13	28	45	29	17	29	49	30	21	30	53	31	25	30	16	17	18	19	20
	40	27	11	27	43	28	15	28	47	29	19	29	51	30	23	30	55	31	27	40	21	22	23	25	26
	50	27	13	27	45	28	17	28	49	29	21	29	53	30	25	30	57	31	29	50	27	28	29	30	31
68	0	27	15	27	47	28	19	28	51	29	23	29	55	30	28	31	0	31	32	0	0	1	2	3	4
	10	27	17	27	49	28	21	28	53	29	26	29	58	30	30	31	2	31	34	10	5	6	8	9	10
	20	27	19	27	51	28	23	28	55	29	28	30	0	30	32	31	4	31	36	20	11	12	13	14	15
	30	27	21	27	53	28	25	28	57	29	30	30	2	30	34	31	6	31	38	30	16	17	18	19	20
	40	27	23	27	55	28	27	28	59	29	32	30	4	30	36	31	8	31	40	40	21	22	24	25	26
	50	27	25	27	57	28	29	29	2	29	34	30	6	30	38	31	11	31	43	50	27	28	29	30	31
69	0	27	27	27	59	28	31	29	4	29	36	30	8	30	40	31	13	31	45	0	0	1	2	3	4
	10	27	29	28	1	28	33	29	6	29	38	30	10	30	42	31	15	31	47	10	5	6	8	9	10
	20	27	30	28	3	28	35	29	8	29	40	30	12	30	45	31	17	31	49	20	11	12	13	14	15
	30	27	32	28	5	28	37	29	9	29	42	30	14	30	47	31	19	31	51	30	16	17	18	19	21
	40	27	34	28	6	28	39	29	11	29	44	30	16	30	49	31	21	31	53	40	22	23	24	25	26
	50	27	36	28	8	28	41	29	13	29	46	30	18	30	51	31	23	31	55	50	27	28	29	30	31

Add for lt. of Sun.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	0″	0″	1″	1″	1″	1″	2″	2″	2″

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.						Add for Minutes of Alt.	
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″		
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″		
70	0	17	37	17	57	18	18	18	38	18	59	19	20	19	40	20	1	20	21	0	0	1	1	2	3	′	″
	10	17	28	17	49	18	9	18	29	18	50	19	10	19	31	19	51	20	11	10	3	4	5	5	6	0	10
	20	17	19	17	40	18	0	18	20	18	41	19	1	19	21	19	41	20	1	20	7	7	8	9	9	1	9
	30	17	11	17	31	17	51	18	11	18	31	18	51	19	12	19	32	19	52	30	10	11	11	12	13	2	8
	40	17	3	17	23	17	43	18	2	18	22	18	42	19	2	19	22	19	42	40	13	14	15	15	16	3	7
	50	16	55	17	14	17	34	17	53	18	13	18	33	18	52	19	12	19	32	50	17	17	18	19	19	4	6
71	0	16	46	17	5	17	25	17	44	18	4	18	23	18	43	19	2	19	22	0	0	1	1	2	3	5	5
	10	16	37	16	56	17	16	17	35	17	55	18	14	18	33	18	53	19	12	10	3	4	4	5	6	6	4
	20	16	29	16	48	17	7	17	26	17	45	18	5	18	24	18	43	19	2	20	6	7	8	8	9	7	4
	30	16	20	16	39	16	58	17	17	17	36	17	55	18	14	18	33	18	52	30	10	10	11	11	12	8	3
	40	16	12	16	30	16	49	17	8	17	27	17	46	18	5	18	23	18	42	40	13	13	14	15	15	9	2
	50	16	3	16	21	16	40	16	59	17	18	17	36	17	55	18	14	18	32	50	16	16	17	18	18		
72	0	15	54	16	13	16	31	16	50	17	8	17	27	17	45	18	4	18	22	0	0	1	1	2	2		
	10	15	46	16	4	16	22	16	41	16	59	17	17	17	36	17	54	18	13	10	3	4	4	5	5	′	″
	20	15	37	15	55	16	13	16	32	16	50	17	8	17	26	17	44	18	3	20	6	7	7	8	8	0	10
	30	15	28	15	46	16	4	16	22	16	40	16	59	17	17	17	35	17	53	30	9	10	10	11	11	1	9
	40	15	20	15	38	15	55	16	13	16	31	16	49	17	7	17	25	17	43	40	12	13	13	14	14	2	8
	50	15	12	15	29	15	46	16	4	16	22	16	40	16	57	17	15	17	33	50	15	16	16	17	17	3	7
73	0	15	3	15	20	15	37	15	55	16	12	16	30	16	48	17	5	17	23	0	0	1	1	2	2	4	6
	10	14	54	15	11	15	28	15	46	16	3	16	21	16	38	16	55	17	13	10	3	3	4	5	5	5	5
	20	14	45	15	2	15	19	15	37	15	54	16	11	16	28	16	45	17	3	20	6	6	7	7	8	6	4
	30	14	36	14	53	15	10	15	27	15	44	16	2	16	19	16	36	16	53	30	9	9	10	10	11	7	4
	40	14	28	14	44	15	1	15	18	15	35	15	52	16	9	16	26	16	43	40	11	12	12	13	14	8	3
	50	14	19	14	36	14	52	15	9	15	26	15	42	15	59	16	16	16	33	50	14	15	15	16	16	9	2
74	0	14	11	14	27	14	43	15	0	15	16	15	33	15	49	16	6	16	23	0	0	1	1	2	2		
	10	14	2	14	18	14	34	14	51	15	7	15	23	15	40	15	56	16	12	10	3	3	4	4	5	′	″
	20	13	53	14	9	14	25	14	41	14	58	15	14	15	30	15	46	16	2	20	5	6	6	7	7	0	10
	30	13	44	14	0	14	16	14	32	14	48	15	4	15	20	15	36	15	52	30	8	9	9	10	10	1	9
	40	13	36	13	51	14	7	14	23	14	39	14	55	15	10	15	26	15	42	40	11	11	12	12	13	2	8
	50	13	27	13	42	13	58	14	14	14	29	14	45	15	1	15	16	15	32	50	13	14	14	15	15	3	7
75	0	13	18	13	33	13	49	14	4	14	20	14	35	14	51	15	6	15	22	0	0	1	1	2	2	4	6
	10	13	9	13	24	13	40	13	55	14	10	14	26	14	41	14	57	15	12	10	3	3	4	4	5	5	5
	20	13	0	13	15	13	31	13	46	14	1	14	16	14	31	14	47	15	2	20	5	6	6	7	7	6	4
	30	12	51	13	6	13	22	13	37	13	52	14	7	14	22	14	37	14	52	30	8	8	9	9	10	7	3
	40	12	42	12	58	13	12	13	27	13	42	13	57	14	12	14	27	14	42	40	10	11	11	12	12	8	2
	50	12	33	12	49	13	3	13	18	13	33	13	47	14	2	14	17	14	31	50	13	13	14	14	15	9	2
76	0	12	25	12	40	12	54	13	9	13	23	13	38	13	52	14	7	14	21	0	0	0	1	1	2		
	10	12	16	12	31	12	45	12	59	13	14	13	28	13	42	13	57	14	11	10	2	3	3	4	4	′	″
	20	12	7	12	22	12	36	12	50	13	4	13	18	13	33	13	47	14	1	20	5	5	6	6	7	0	10
	30	11	58	12	13	12	27	12	41	12	55	13	9	13	23	13	37	13	51	30	7	7	8	8	9	1	9
	40	11	49	12	4	12	18	12	31	12	45	12	59	13	13	13	27	13	41	40	9	10	10	11	11	2	8
	50	11	41	11	55	12	8	12	22	12	36	12	49	13	3	13	17	13	30	50	12	12	13	13	14	3	7
77	0	11	32	11	46	11	59	12	13	12	26	12	40	12	53	13	7	13	20	0	0	0	1	1	2	4	6
	10	11	23	11	37	11	50	12	3	12	17	12	30	12	43	12	57	13	10	10	2	3	3	4	4	5	5
	20	11	14	11	28	11	41	11	54	12	7	12	20	12	33	12	47	13	0	20	4	5	5	6	6	6	4
	30	11	5	11	19	11	32	11	45	11	57	12	11	12	24	12	37	12	50	30	7	7	7	8	8	7	3
	40	10	56	11	10	11	22	11	35	11	48	12	1	12	14	12	27	12	39	40	9	9	10	10	10	8	2
	50	10	48	11	1	11	13	11	26	11	39	11	51	12	4	12	16	12	29	50	11	11	12	12	13	9	1
78	0	10	39	10	52	11	4	11	16	11	29	11	41	11	54	12	6	12	19	0	0	0	1	1	2		
	10	10	30	10	42	10	55	11	7	11	19	11	32	11	44	11	56	12	9	10	2	2	3	3	4	′	″
	20	10	21	10	33	10	46	10	58	11	10	11	22	11	34	11	46	11	58	20	4	4	5	5	6	0	10
	30	10	12	10	24	10	36	10	48	11	0	11	12	11	24	11	36	11	48	30	6	6	7	7	8	1	9
	40	10	4	10	15	10	27	10	39	10	51	11	2	11	14	11	26	11	38	40	8	8	9	9	10	2	8
	50	9	55	10	6	10	18	10	29	10	41	10	53	11	4	11	16	11	28	50	10	10	11	11	12	3	7
79	0	9	46	9	57	10	9	10	20	10	31	10	43	10	54	11	6	11	17	0	0	0	1	1	1	4	6
	10	9	37	9	48	9	59	10	11	10	22	10	33	10	44	10	56	11	7	10	2	2	3	3	3	5	5
	20	9	28	9	39	9	50	10	1	10	12	10	23	10	34	10	46	10	57	20	4	4	4	5	5	6	4
	30	9	19	9	30	9	41	9	52	10	3	10	14	10	25	10	36	10	47	30	5	6	6	7	7	7	3
	40	9	10	9	21	9	32	9	42	9	53	10	4	10	15	10	25	10	36	40	7	8	8	8	9	8	2
	50	9	1	9	12	9	22	9	33	9	43	9	54	10	5	10	15	10	26	50	9	9	10	10	11	9	1

TABLE XXX.*

Auxiliary Arcs.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″
70	0	27	38	28	10	28	43	29	15	29	48	30	20	30	53	31	25	31	57	0	0	1	2	3	4
	10	27	40	28	12	28	45	29	17	29	50	30	22	30	55	31	27	31	59	10	5	6	8	9	10
	20	27	41	28	14	28	46	29	19	29	52	30	24	30	57	31	29	32	1	20	11	12	13	14	15
	30	27	43	28	16	28	48	29	21	29	54	30	26	30	59	31	31	32	3	30	16	17	18	19	21
	40	27	45	28	18	28	50	29	23	29	55	30	28	31	0	31	33	32	5	40	22	23	24	25	26
	50	27	47	28	19	28	52	29	24	29	57	30	30	31	2	31	35	32	7	50	27	28	29	30	31
71	0	27	48	28	21	28	54	29	26	29	59	30	32	31	4	31	37	32	9	0	0	1	2	3	4
	10	27	50	28	23	28	55	29	28	30	1	30	34	31	6	31	39	32	11	10	5	7	8	9	10
	20	27	52	28	24	28	57	29	30	30	3	30	35	31	8	31	41	32	13	20	11	12	13	14	15
	30	27	53	28	26	28	59	29	32	30	4	30	37	31	10	31	43	32	15	30	16	17	19	20	21
	40	27	55	28	28	29	1	29	33	30	6	30	39	31	12	31	44	32	17	40	22	23	24	25	26
	50	27	57	28	29	29	2	29	35	30	8	30	41	31	14	31	46	32	19	50	27	28	29	31	32
72	0	27	58	28	31	29	4	29	37	30	10	30	42	31	15	31	48	32	21	0	0	1	2	3	4
	10	28	0	28	33	29	6	29	38	30	11	30	44	31	17	31	50	32	23	10	6	7	8	9	10
	20	28	1	28	34	29	7	29	40	30	13	30	46	31	19	31	52	32	25	20	11	12	13	14	15
	30	28	3	28	36	29	9	29	42	30	15	30	48	31	21	31	54	32	27	30	16	18	19	20	21
	40	28	5	28	37	29	11	29	44	30	17	30	49	31	22	31	55	32	28	40	22	23	24	25	26
	50	28	6	28	39	29	12	29	45	30	18	30	51	31	24	31	57	32	30	50	27	29	30	31	32
73	0	28	8	28	41	29	14	29	47	30	20	30	53	31	26	31	59	32	32	0	0	1	2	3	4
	10	28	9	28	42	29	15	29	48	30	21	30	54	31	27	32	0	32	34	10	6	7	8	9	10
	20	28	11	28	44	29	17	29	50	30	23	30	56	31	29	32	2	32	35	20	11	12	13	14	15
	30	28	12	28	45	29	19	29	52	30	25	30	58	31	31	32	4	32	37	30	16	18	19	20	21
	40	28	14	28	47	29	20	29	53	30	26	30	59	31	33	32	6	32	39	40	22	23	24	25	26
	50	28	15	28	48	29	22	29	55	30	28	31	1	31	34	32	7	32	40	50	27	29	30	31	32
74	0	28	16	28	50	29	23	29	56	30	30	31	3	31	36	32	9	32	42	0	0	1	2	3	4
	10	28	18	28	51	29	24	29	58	30	31	31	4	31	37	32	10	32	44	10	6	7	8	9	10
	20	28	19	28	53	29	26	29	59	30	32	31	6	31	39	32	12	32	45	20	11	12	13	14	16
	30	28	21	28	54	29	27	30	1	30	34	31	7	31	40	32	14	32	47	30	17	18	19	20	21
	40	28	22	28	55	29	29	30	2	30	35	31	9	31	42	32	15	32	49	40	22	23	24	25	27
	50	28	24	28	57	29	30	30	4	30	37	31	10	31	44	32	17	32	50	50	28	29	30	31	32
75	0	28	25	28	58	29	32	30	5	30	38	31	12	31	45	32	18	32	52	0	0	1	2	3	4
	10	28	26	29	0	29	33	30	6	30	40	31	13	31	47	32	20	32	53	10	6	7	8	9	10
	20	28	28	29	1	29	34	30	8	30	42	31	15	31	48	32	21	32	55	20	11	12	13	14	16
	30	28	29	29	2	29	36	30	9	30	43	31	16	31	50	32	23	32	56	30	17	18	19	20	21
	40	28	30	29	4	29	37	30	11	30	44	31	18	31	51	32	24	32	58	40	22	23	24	26	27
	50	28	32	29	5	29	38	30	12	30	46	31	19	31	52	32	26	32	59	50	28	29	30	31	32
76	0	28	33	29	6	29	40	30	13	30	47	31	20	31	54	32	27	33	1	0	0	1	2	3	4
	10	28	34	29	8	29	41	30	15	30	48	31	22	31	55	32	29	33	2	10	6	7	8	9	10
	20	28	35	29	9	29	42	30	16	30	50	31	23	31	56	32	30	33	3	20	11	12	13	15	16
	30	28	37	29	10	29	44	30	17	30	51	31	25	31	58	32	32	33	5	30	17	18	19	20	21
	40	28	38	29	11	29	45	30	18	30	52	31	26	31	59	32	33	33	7	40	22	23	25	26	27
	50	28	39	29	13	29	46	30	20	30	53	31	27	32	1	32	34	33	8	50	28	29	30	31	32
77	0	28	40	29	14	29	48	30	21	30	55	31	28	32	2	32	36	33	9	0	0	1	2	3	4
	10	28	41	29	15	29	49	30	23	30	56	31	30	32	3	32	37	33	11	10	6	7	8	9	10
	20	28	43	29	16	29	50	30	24	30	57	31	31	32	5	32	38	33	12	20	11	12	13	15	16
	30	28	44	29	17	29	51	30	25	30	59	31	32	32	6	32	39	33	13	30	17	18	19	20	21
	40	28	45	29	19	29	52	30	26	31	0	31	33	32	7	32	41	33	15	40	22	23	25	26	27
	50	28	46	29	20	29	54	30	27	31	1	31	35	32	8	32	42	33	16	50	28	29	30	31	32
78	0	28	47	29	21	29	55	30	28	31	2	31	36	32	10	32	43	33	17	0	0	1	2	3	4
	10	28	48	29	22	29	56	30	30	31	3	31	37	32	11	32	45	33	18	10	6	7	8	9	10
	20	28	49	29	23	29	57	30	31	31	4	31	38	32	12	32	46	33	19	20	11	12	13	15	16
	30	28	50	29	24	29	58	30	32	31	5	31	39	32	13	32	47	33	21	30	17	18	19	20	21
	40	28	51	29	25	29	59	30	33	31	7	31	40	32	14	32	48	33	22	40	23	24	25	26	27
	50	28	52	29	26	30	0	30	34	31	8	31	41	32	15	32	49	33	23	50	28	29	30	32	33
79	0	28	53	29	27	30	1	30	35	31	9	31	43	32	16	32	50	33	24	0	0	1	2	3	4
	10	28	54	29	28	30	2	30	36	31	10	31	44	32	18	32	51	33	25	10	6	7	8	9	10
	20	28	55	29	29	30	3	30	37	31	11	31	45	32	19	32	53	33	26	20	11	12	13	15	16
	30	28	56	29	30	30	4	30	38	31	12	31	46	32	20	32	54	33	27	30	17	18	19	20	21
	40	28	57	29	31	30	5	30	39	31	13	31	47	32	21	32	55	33	29	40	23	24	25	26	27
	50	28	58	29	32	30	6	30	40	31	14	31	48	32	22	32	56	33	30	50	28	29	30	32	33

Add for Alt. of Sun.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.

°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	0″	0″	0″	1″	1″	1″	1″	1″	1″

TABLE XXX.

CORRECTION OF THE MOON'S APPARENT ALTITUDE.

☽App. Alt.	Horizontal Parallax.									Add for Sec. of Par.						Add for Minutes of Alt.
	53′	54′	55′	56′	57′	58′	59′	60′	61′		0″	2″	4″	6″	8″	
° ′	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	′ ″	″	″	″	″	″	″	
80 0	8 52	9 3	9 13	9 23	9 34	9 44	9 55	10 5	10 15	0	0	0	1	1	1	′ ″
10	8 43	8 53	9 4	9 14	9 24	9 34	9 45	9 55	10 5	10	2	2	2	3	3	0 10
20	8 34	8 44	8 54	9 5	9 15	9 25	9 35	9 45	9 55	20	3	4	4	4	5	1 9
30	8 25	8 35	8 45	8 55	9 5	9 15	9 25	9 35	9 45	30	5	5	6	6	6	2 8
40	8 16	8 26	8 36	8 46	8 55	9 5	9 15	9 24	9 34	40	7	7	7	8	8	3 7
50	8 7	8 17	8 27	8 36	8 46	8 55	9 5	9 14	9 24	50	8	9	9	9	10	4 6
81 0	7 58	8 8	8 17	8 27	8 36	8 45	8 55	9 4	9 14	0	0	0	1	1	1	5 5
10	7 49	7 59	8 8	8 17	8 26	8 36	8 45	8 54	9 3	10	1	2	2	2	3	6 4
20	7 40	7 50	7 59	8 8	8 17	8 26	8 35	8 44	8 53	20	3	3	4	4	4	7 3
30	7 31	7 40	7 49	7 58	8 7	8 16	8 25	8 34	8 42	30	4	5	5	5	6	8 2
40	7 22	7 31	7 40	7 49	7 57	8 6	8 15	8 23	8 32	40	6	6	7	7	7	9 1
50	7 13	7 22	7 31	7 39	7 48	7 56	8 5	8 13	8 22	50	7	8	8	8	9	
82 0	7 4	7 13	7 21	7 30	7 38	7 46	7 55	8 3	8 11	0	0	0	1	1	1	
10	6 55	7 4	7 12	7 20	7 28	7 36	7 45	7 53	8 1	10	1	2	2	2	2	′ ″
20	6 46	6 55	7 3	7 11	7 19	7 27	7 35	7 43	7 51	20	3	3	3	3	4	0 10
30	6 37	6 45	6 53	7 1	7 9	7 17	7 25	7 32	7 40	30	4	4	4	5	5	1 9
40	6 28	6 36	6 44	6 52	6 59	7 7	7 15	7 22	7 30	40	5	5	6	6	6	2 8
50	6 19	6 27	6 35	6 42	6 50	6 57	7 4	7 12	7 19	50	7	7	7	7	8	3 7
83 0	6 10	6 18	6 25	6 32	6 40	6 47	6 54	7 2	7 9	0	0	0	0	1	1	4 6
10	6 1	6 9	6 16	6 23	6 30	6 37	6 44	6 52	6 59	10	1	1	2	2	2	5 5
20	5 52	5 59	6 6	6 13	6 20	6 27	6 34	6 41	6 48	20	2	2	3	3	3	6 4
30	5 43	5 50	5 57	6 4	6 11	6 17	6 24	6 31	6 38	30	3	4	4	4	4	7 3
40	5 34	5 41	5 48	5 54	6 1	6 8	6 14	6 21	6 27	40	5	5	5	5	5	8 2
50	5 25	5 32	5 38	5 45	5 51	5 58	6 4	6 11	6 17	50	6	6	6	6	7	9 1
84 0	5 16	5 23	5 29	5 35	5 42	5 48	5 54	6 0	6 7	0	0	0	0	1	1	
10	5 7	5 13	5 20	5 26	5 32	5 38	5 44	5 50	5 56	10	1	1	1	2	2	′ ″
20	4 58	5 4	5 10	5 16	5 22	5 28	5 34	5 40	5 46	20	2	2	2	2	3	0 10
30	4 49	4 55	5 1	5 7	5 12	5 18	5 24	5 30	5 35	30	3	3	3	3	4	1 9
40	4 40	4 45	4 51	4 57	5 3	5 8	5 14	5 19	5 25	40	4	4	4	4	5	2 8
50	4 31	4 36	4 42	4 47	4 53	4 58	5 4	5 9	5 14	50	5	5	5	5	6	3 7
85 0	4 22	4 27	4 33	4 38	4 43	4 48	4 54	4 59	5 4	0	0	0	0	0	1	4 6
10	4 13	4 18	4 23	4 28	4 33	4 38	4 43	4 49	4 54	10	1	1	1	1	1	5 5
20	4 4	4 9	4 14	4 19	4 24	4 28	4 33	4 38	4 43	20	2	2	2	2	2	6 4
30	3 55	4 0	4 4	4 9	4 14	4 19	4 23	4 28	4 33	30	2	2	3	3	3	7 3
40	3 46	3 50	3 55	4 0	4 4	4 9	4 13	4 18	4 22	40	3	3	3	4	4	8 2
50	3 37	3 41	3 46	3 50	3 54	3 59	4 3	4 7	4 12	50	4	4	4	4	5	9 1
86 0	3 28	3 32	3 36	3 40	3 45	3 49	3 53	3 57	4 1	0	0	0	0	0	0	
10	3 19	3 23	3 27	3 31	3 35	3 39	3 43	3 47	3 51	10	1	1	1	1	1	′ ″
20	3 10	3 14	3 17	3 21	3 25	3 29	3 33	3 37	3 40	20	1	1	1	2	2	0 10
30	3 1	3 4	3 8	3 12	3 15	3 19	3 23	3 26	3 30	30	2	2	2	2	2	1 9
40	2 52	2 55	2 59	3 2	3 6	3 9	3 13	3 16	3 20	40	2	3	3	3	3	2 8
50	2 43	2 46	2 49	2 52	2 56	2 59	3 2	3 6	3 9	50	3	3	3	3	4	3 7
87 0	2 33	2 37	2 40	2 43	2 46	2 49	2 52	2 55	2 59	0	0	0	0	0	0	4 6
10	2 24	2 27	2 30	2 33	2 36	2 39	2 42	2 45	2 48	10	0	1	1	1	1	5 5
20	2 15	2 18	2 21	2 24	2 26	2 29	2 32	2 35	2 38	20	1	1	1	1	1	6 4
30	2 6	2 9	2 11	2 14	2 17	2 19	2 22	2 25	2 27	30	1	1	1	2	2	7 3
40	1 57	2 0	2 2	2 4	2 7	2 9	2 12	2 14	2 17	40	2	2	2	2	2	8 2
50	1 48	1 50	1 53	1 55	1 57	1 59	2 2	2 4	2 6	50	2	2	2	2	3	9 1
88 0	1 39	1 41	1 43	1 45	1 47	1 49	1 52	1 54	1 56	0	0	0	0	0	0	
10	1 30	1 32	1 34	1 36	1 38	1 40	1 41	1 43	1 45	10	0	0	0	0	0	′ ″
20	1 21	1 23	1 24	1 26	1 28	1 30	1 31	1 33	1 35	20	1	1	1	1	1	0 10
30	1 12	1 13	1 15	1 16	1 18	1 20	1 21	1 23	1 24	30	1	1	1	1	1	1 9
40	1 3	1 4	1 5	1 7	1 8	1 10	1 11	1 12	1 14	40	1	1	1	1	1	2 8
50	0 54	0 55	0 56	0 57	0 58	1 0	1 1	1 2	1 3	50	1	1	1	1	2	3 7
89 0	0 45	0 46	0 47	0 48	0 49	0 50	0 51	0 52	0 53	0	0	0	0	0	0	4 6
10	0 35	0 36	0 37	0 38	0 39	0 40	0 41	0 42	0 42	10	0	0	0	0	0	5 5
20	0 26	0 27	0 28	0 28	0 29	0 30	0 31	0 31	0 32	20	0	0	0	0	0	6 4
30	0 17	0 18	0 18	0 19	0 19	0 20	0 20	0 21	0 21	30	0	0	0	0	0	7 3
40	0 8	0 9	0 9	0 9	0 10	0 10	0 10	0 11	0 11	40	0	0	0	0	0	8 2
50	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0	50	1	1	1	1	1	9 1

TABLE XXX.*

Auxiliary Arcs.—Add 60 degrees to the minutes and seconds taken from the Table.

☽ App. Alt.		Horizontal Parallax.																		Add for Sec. of Par.					
		53′		54′		55′		56′		57′		58′		59′		60′		61′			0″	2″	4″	6″	8″
°	′	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	′	″	″	″	″	″	″	″
80	0	28	59	29	33	30	7	30	41	31	15	31	49	32	23	32	57	33	31	0	0	1	2	3	4
	10	29	0	29	34	30	8	30	42	31	16	31	50	32	24	32	58	33	32	10	6	7	8	9	10
	20	29	1	29	35	30	9	30	43	31	17	31	51	32	25	32	59	33	33	20	11	12	14	15	16
	30	29	2	29	36	30	10	30	44	31	18	31	52	32	26	33	0	33	34	30	17	18	19	20	21
	40	29	2	29	37	30	11	30	45	31	19	31	53	32	27	33	1	33	35	40	23	24	25	26	27
	50	29	3	29	37	30	12	30	46	31	20	31	54	32	28	33	2	33	36	50	28	29	31	32	33
81	0	29	4	29	38	30	12	30	46	31	21	31	55	32	29	33	3	33	37	0	0	1	2	3	4
	10	29	5	29	39	30	13	30	47	31	21	31	55	32	30	33	4	33	38	10	6	7	8	9	10
	20	29	6	29	40	30	14	30	48	31	22	31	56	32	31	33	5	33	39	20	11	12	14	15	16
	30	29	6	29	41	30	15	30	49	31	23	31	57	32	31	33	5	33	39	30	17	18	19	20	21
	40	29	7	29	41	30	16	30	50	31	24	31	58	32	32	33	6	33	40	40	23	24	25	26	27
	50	29	8	29	42	30	16	30	51	31	25	31	59	32	33	33	7	33	41	50	28	29	31	32	33
82	0	29	9	29	43	30	17	30	51	31	26	32	0	32	34	33	8	33	42	0	0	1	2	3	5
	10	29	10	29	44	30	18	30	52	31	26	32	0	32	35	33	9	33	43	10	6	7	8	9	10
	20	29	10	29	44	30	19	30	53	31	27	32	1	32	35	33	9	33	44	20	11	13	14	15	16
	30	29	11	29	45	30	19	30	54	31	28	32	2	32	36	33	10	33	45	30	17	18	19	21	22
	40	29	12	29	46	30	20	30	54	31	29	32	3	32	37	33	11	33	45	40	23	24	25	26	27
	50	29	12	29	47	30	21	30	55	31	29	32	3	32	38	33	12	33	46	50	28	30	31	32	33
83	0	29	13	29	47	30	21	30	56	31	30	32	4	32	38	33	12	33	47	0	0	1	2	3	5
	10	29	13	29	48	30	22	30	56	31	30	32	5	32	39	33	13	33	48	10	6	7	8	9	10
	20	29	14	29	48	30	23	30	57	31	31	32	6	32	40	33	14	33	48	20	11	13	14	15	16
	30	29	15	29	49	30	23	30	58	31	32	32	6	32	40	33	15	33	49	30	17	18	19	21	22
	40	29	15	29	50	30	24	30	58	31	33	32	7	32	41	33	15	33	49	40	23	24	25	26	27
	50	29	16	29	50	30	24	30	59	31	33	32	7	32	42	33	16	33	50	50	28	30	31	32	33
84	0	29	16	29	51	30	25	30	59	31	34	32	8	32	42	33	16	33	51	0	0	1	2	3	5
	10	29	17	29	51	30	26	31	0	31	34	32	9	32	43	33	17	33	51	10	6	7	8	9	10
	20	29	17	29	52	30	26	31	1	31	35	32	9	32	43	33	18	33	52	20	11	13	14	15	16
	30	29	18	29	52	30	27	31	1	31	35	32	10	32	44	33	18	33	53	30	17	18	19	21	22
	40	29	19	29	53	30	27	31	2	31	36	32	10	32	45	33	19	33	53	40	23	24	25	26	28
	50	29	19	29	54	30	28	31	2	31	36	32	11	32	45	33	19	33	54	50	29	30	31	32	33
85	0	29	20	29	54	30	28	31	3	31	37	32	11	32	46	33	20	33	54	0	0	1	2	3	5
	10	29	20	29	54	30	28	31	3	31	37	32	12	32	46	33	20	33	55	10	6	7	8	9	10
	20	29	20	29	55	30	29	31	4	31	38	32	12	32	47	33	21	33	55	20	11	13	14	15	16
	30	29	21	29	55	30	29	31	4	31	39	32	13	32	47	33	22	33	56	30	17	18	19	21	22
	40	29	21	29	56	30	30	31	4	31	39	32	13	32	47	33	22	33	56	40	23	24	25	26	28
	50	29	22	29	56	30	31	31	5	31	39	32	14	32	48	33	22	33	57	50	29	30	31	32	33
86	0	29	22	29	56	30	31	31	5	31	40	32	14	32	48	33	23	33	57	0	0	1	2	3	5
	10	29	22	29	57	30	31	31	6	31	40	32	14	32	49	33	23	33	57	10	6	7	8	9	10
	20	29	23	29	57	30	32	31	6	31	40	32	15	32	49	33	24	33	58	20	11	13	14	15	16
	30	29	23	29	58	30	32	31	6	31	41	32	15	32	50	33	24	33	58	30	17	18	19	21	22
	40	29	23	29	58	30	32	31	7	31	41	32	16	32	50	33	24	33	59	40	23	24	25	26	28
	50	29	24	29	58	30	32	31	7	31	41	32	16	32	50	33	25	33	59	50	29	30	31	32	33
87	0	29	24	29	58	30	33	31	7	31	42	32	16	32	50	33	25	33	59	0	0	1	2	3	5
	10	29	24	29	59	30	33	31	8	31	42	32	16	32	51	33	25	34	0	10	6	7	8	9	10
	20	29	24	29	59	30	33	31	8	31	42	32	17	32	51	33	26	34	0	20	11	13	14	15	16
	30	29	25	29	59	30	34	31	8	31	43	32	17	32	51	33	26	34	0	30	17	18	19	21	22
	40	29	25	29	59	30	34	31	8	31	43	32	17	32	51	33	26	34	0	40	23	24	25	26	28
	50	29	25	30	0	30	34	31	8	31	43	32	17	32	52	33	26	34	1	50	29	30	31	32	33
88	0	29	25	30	0	30	34	31	9	31	43	32	18	32	52	33	26	34	1	0	0	1	2	3	5
	10	29	26	30	0	30	34	31	9	31	43	32	18	32	52	33	27	34	1	10	6	7	8	9	10
	20	29	26	30	0	30	35	31	9	31	44	32	18	32	52	33	27	34	1	20	11	13	14	15	16
	30	29	26	30	0	30	35	31	9	31	44	32	18	32	53	33	27	34	1	30	17	18	19	21	22
	40	29	26	30	0	30	35	31	9	31	44	32	18	32	53	33	27	34	1	40	23	24	25	26	28
	50	29	26	30	0	30	35	31	10	31	44	32	19	32	53	33	27	34	2	50	29	30	31	32	33
89	0	29	26	30	0	30	35	31	10	31	44	32	19	32	53	33	27	34	2	0	0	1	2	3	5
	10	29	26	30	1	30	35	31	10	31	44	32	19	32	53	33	27	34	2	10	6	7	8	9	10
	20	29	26	30	1	30	35	31	10	31	44	32	19	32	53	33	27	34	2	20	11	13	14	15	16
	30	29	26	30	1	30	35	31	10	31	44	32	19	32	53	33	27	34	2	30	17	18	20	21	22
	40	29	26	30	1	30	35	31	10	31	44	32	19	32	53	33	27	34	2	40	23	24	25	26	28
	50	29	26	30	1	30	35	31	10	31	44	32	19	32	53	33	27	34	2	50	29	30	31	32	33

Add for Alt. of Sun.	
°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	2
10	2
20	2
30	3
40	3
50	4
60	4
70	5
80	5
90	5

Add for Alt. of Star.	
°	″
3	8
4	5
5	4
6	3
7	2
8	2
9	1
10	1
20	0
30	0
40	0
50	0
60	0
70	0
80	0
90	0

Add for Minutes of Moon's Alt.	1′	2′	3′	4′	5′	6′	7′	8′	9′
	0″	0′	0″	0″	0″	0″	0″	0″	1″

TABLE XXXI.

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

. 0 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	$\frac{3}{4}$.	51921	12127	17345	72333	91715	07551	20941	32539	42770	51921	69200		
1	$\frac{4}{5}$.67757	74710	81147	87139	92745	98011	02976	07672	12127	16365	20406	24267		
2	5.27963	31509	34916	38194	41352	44400	46345	50193	52951	55623	58216	60731		
3	63181	65561	67877	70133	72332	74477	76570	78614	80611	82563	84472	86340		
4	$\frac{5}{6}$.88168	89959	91714	93434	95121	96775	98399	99992	01557	03095	04605	06090		
5	6.07550	08985	10398	11787	13155	14502	15828	17134	18421	19689	20938	22170		
6	23385	24583	25765	26931	28081	29217	30337	31441	32536	33615	34681	35734		
7	36774	37802	38817	39821	40814	41795	42766	43726	44675	45614	46543	47462		
8	48372	49271	50162	51044	51916	52780	53636	54484	55323	56154	56977	57792		
9	58600	59401	60194	60980	61759	62531	63296	64054	64806	65552	66291	67024		
10	6.67751	68471	69186	69895	70598	71296	71988	72674	73355	74031	74702	75367	s	
11	76028	76683	77334	77979	78620	79256	79888	80515	81137	81756	82369	82979	1	119
12	83584	84185	84782	85374	85963	86548	87129	87706	88279	88848	89414	89976	2	238
13	90535	91089	91641	92189	92733	93274	93812	94346	94877	95405	95930	96451	3	358
14	$\frac{6}{7}$.96970	97485	97997	98506	99013	99516	00017	00514	01009	01501	01990	02476	4	476
15	7.02960	03441	03920	04395	04869	05339	05807	06273	06736	07196	07655	08110	s	
16	08564	09015	09464	09910	10354	10796	11236	11673	12108	12541	12972	13401	1	84
17	13827	14252	14674	15095	15513	15930	16344	16756	17167	17575	17982	18387	2	168
18	18790	19191	19590	19987	20383	20776	21168	21558	21947	22333	22719	23102	3	252
19	23483	23863	24241	24618	24993	25366	25738	26108	26477	26844	27210	27573	4	336
20	7.27936	28297	28656	29014	29371	29726	30079	30431	30782	31131	31479	31826	s	
21	32171	32515	32857	33198	33538	33876	34213	34549	34884	35217	35549	35879	1	65
22	36209	36537	36864	37189	37514	37837	38159	38480	38800	39118	39435	39752	2	130
23	40067	40380	40693	41005	41315	41625	41933	42240	42546	42851	43155	43458	3	195
24	43760	44061	44361	44659	44957	45254	45549	45844	46138	46430	46722	47013	4	260
25	7.47302	47591	47879	48166	48452	48737	49021	49304	49586	49867	50148	50427	s	
26	50706	50983	51260	51536	51811	52085	52358	52631	52902	53173	53443	53712	1	53
27	53980	54247	54514	54780	55045	55308	55572	55834	56096	56357	56617	56876	2	106
28	57135	57393	57650	57906	58162	58416	58670	58924	59176	59428	59679	59929	3	159
29	60179	60428	60676	60924	61170	61417	61662	61907	62151	62394	62636	62878	4	212
30	7.63120	63360	63600	63839	64078	64316	64553	64790	65026	65261	65496	65730	s	
31	65964	66196	66429	66660	66891	67121	67351	6758	67809	68037	68264	68491	1	45
32	68717	68942	69167	69392	69616	69839	70061	70283	70505	70726	70946	71166	2	90
33	71385	71604	71822	72040	72257	72473	72689	72904	73119	73334	73548	73760	3	134
34	73974	74186	74398	74609	74819	75030	75239	75448	75657	75865	76073	76280	4	178
35	7.76487	76693	76898	77104	77308	77513	77716	77920	78122	78325	78526	78728	s	
36	78929	79129	79329	79529	79728	79926	80124	80322	80519	80716	89912	81108	1	39
37	81303	81498	81693	81887	82081	82274	82467	82659	82851	83043	83234	83424	2	77
38	83615	83804	83994	84183	84372	84560	84747	84935	85122	85308	85494	85680	3	116
39	85866	86050	86235	86419	86603	86786	86969	87152	87334	87516	87697	87878	4	154
40	7.88059	88240	88419	88599	88778	88957	89135	89314	89491	89668	89846	90022	s	
41	90198	90374	90550	90725	90900	91074	91248	91422	91596	91769	91941	92114	1	34
42	92286	92457	92629	92800	92970	93141	93311	93480	93650	93819	93987	94156	2	68
43	94324	94491	94659	94826	94992	95159	95325	95491	95656	95821	95986	96150	3	102
44	96315	96478	96642	96805	96968	97131	97293	97455	97617	97778	97939	98100	4	137
45	$\frac{7}{8}$.98265	98421	98580	98740	98899	99058	99217	99375	99534	99691	99849	00006	s	
46	8.00163	00320	00476	00632	00788	00944	01099	01254	01409	01563	01717	01871	1	31
47	02025	02178	02331	02484	02636	02789	02941	03092	03244	03395	03546	03697	2	62
48	03847	03997	04147	04297	04446	04595	04744	04892	05041	05189	05336	05484	3	92
49	05631	05778	05925	06072	06218	06364	06510	06655	06800	06945	07090	07235	4	122
50	8.07379	07523	07667	07811	07954	08097	08240	08383	08525	08667	08809	08951	s	
51	09092	09233	09374	09515	09656	09796	09936	10076	10216	10355	10494	10633	1	27
52	10772	10910	11048	11187	11324	11462	11599	11736	11873	12010	12147	12283	2	55
53	12419	12555	12691	12826	12961	13096	13231	13366	13500	13634	13768	13902	3	82
54	14035	14169	14302	14434	14567	14700	14832	14964	15096	15228	15359	15490	4	110
55	8.15621	15752	15883	16013	16144	16274	16404	16533	16663	16792	16921	17050	s	
56	17179	17307	17436	17564	17692	17820	17947	18074	18202	18329	18455	18582	1	25
57	18708	18835	18961	19087	19212	19338	19463	19588	19713	19838	19963	20087	2	50
58	20211	20335	20459	20583	20706	20830	20953	21076	21198	21321	21444	21566	3	75
59	21688	21810	21932	22053	22175	22296	22417	22538	22658	22779	22899	23019	4	100

TABLE XXXI.

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

1 Hour.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	8.23140	23259	23379	23499	23618	23737	23856	23975	24094	24212	24331	24449	s	
1	24567	24685	24802	24920	25037	25155	25272	25389	25505	25622	25738	25855	1	23
2	25971	26087	26203	26318	26434	26549	26664	26779	26894	27009	27123	27238	2	46
3	27352	27466	27580	27694	27807	27921	28034	28147	28260	28373	28486	28599	3	70
4	28711	28823	28935	29047	29159	29271	29383	29494	29605	29716	29827	29938	4	93
5	8.30049	30159	30270	30380	30490	30600	30710	30820	30929	31039	31148	31257	s	
6	31366	31475	31583	31692	31800	31909	32016	32125	32233	32340	32448	32556	1	21
7	32663	32770	32877	32984	33091	33198	33304	33410	33517	33623	33729	33835	2	42
8	33940	34046	34151	34257	34362	34467	34572	34677	34782	34886	34991	35095	3	63
9	35199	35303	35407	35511	35614	35718	35821	35925	36028	36131	36234	36337	4	85
10	8.36439	36542	36644	36746	36849	36951	37053	37154	37256	37358	37459	37560	s	
11	37662	37763	37864	37964	38065	38166	38266	38366	38467	38567	38667	38767	1	20
12	38866	38966	39066	39165	39264	39364	39463	39562	39660	39759	39858	39956	2	40
13	40055	40153	40251	40349	40447	40545	40642	40740	40837	40935	41032	41129	3	60
14	41226	41323	41420	41517	41613	41710	41806	41902	41998	42094	42191	42286	4	80
15	8.42382	42477	42573	42668	42764	42859	42954	43049	43144	43238	43333	43427	s	
16	43522	43616	43710	43804	43898	43992	44086	44180	44273	44367	44460	44554	1	18
17	44647	44740	44833	44926	45018	45111	45204	45296	45388	45481	45573	45665	2	37
18	45757	45849	45940	46032	46124	46215	46306	46398	46489	46580	46671	46762	3	55
19	46852	46943	47034	47124	47215	47305	47395	47485	47575	47665	47755	47844	4	74
20	8.47934	48021	48113	48202	48292	48381	48470	48559	48647	48736	48825	48913	s	
21	49002	49090	49179	49267	49355	49443	49531	49619	49706	49794	49882	49969	1	17
22	50056	50144	50231	50318	50405	50492	50579	50665	50752	50839	50925	51012	2	35
23	51098	51184	51270	51356	51442	51528	51614	51699	51785	51871	51956	52041	3	52
24	52127	52212	52297	52382	52467	52552	52636	52721	52805	52890	52974	53059	4	70
25	8.53143	53227	53311	53395	53479	53563	53646	53730	53814	53897	53980	54064	s	
26	54147	54230	54313	54396	54479	54562	54645	54727	54810	54892	54975	55057	1	16
27	55139	55221	55303	55385	55467	55549	55631	55713	55794	55876	55957	56038	2	33
28	56120	56201	56282	56363	56444	56525	56606	56687	56767	56848	56928	57009	3	49
29	57089	57169	57249	57330	57410	57490	57569	57649	57729	57809	57888	57968	4	65
30	8.58047	58126	58206	58285	58364	58443	58522	58601	58680	58759	58837	58916	s	
31	58994	59073	59151	59230	59308	59386	59464	59542	59620	59698	59776	59853	1	15
32	59931	60009	60086	60164	60241	60318	60395	60473	60550	60627	60704	60781	2	31
33	60857	60934	61011	61087	61164	61240	61317	61393	61469	61545	61621	61697	3	46
34	61773	61849	61925	62001	62076	62152	62228	62303	62379	62454	62529	62604	4	62
35	8.62679	62755	62830	62904	62979	63054	63129	63203	63278	63353	63427	63502	s	
36	63576	63650	63724	63798	63872	63946	64020	64094	64168	64242	64315	64389	1	15
37	64463	64536	64609	64683	64756	64829	64902	64975	65048	65121	65194	65267	2	29
38	65340	65412	65485	65558	65630	65703	65775	65847	65920	65992	66064	66136	3	44
39	66208	66280	66352	66424	66496	66567	66639	66710	66782	66853	66925	66996	4	52
40	8.67067	67139	67209	67281	67352	67423	67494	67564	67635	67706	67777	67847	s	
41	67918	67988	68059	68129	68199	68269	68340	68410	68480	68550	68620	68690	1	14
42	68759	68829	68899	68969	69038	69108	69177	69247	69316	69385	69454	69524	2	28
43	69593	69662	69731	69800	69869	69937	70006	70075	70144	70212	70281	70349	3	42
44	70418	70486	70554	70623	70691	70759	70827	70895	70963	71031	71099	71167	4	56
45	8.71234	71302	71370	71437	71505	71572	71640	71707	71774	71842	71909	71976	s	
46	72043	72110	72177	72244	72311	72378	72444	72511	72578	72644	72711	72777	1	13
47	72844	72910	72977	73043	73109	73175	73241	73308	73374	73439	73505	73571	2	26
48	73637	73703	73768	73834	73900	73965	74031	74096	74162	74227	74292	74357	3	40
49	74423	74488	74553	74618	74683	74748	74813	74877	74942	75007	75072	75136	4	53
50	8.75201	75265	75330	75394	75458	75523	75587	75651	75715	75779	75843	75907	s	
51	75971	76035	76099	76163	76227	76290	76354	76418	76481	76545	76608	76672	1	13
52	76735	76798	76862	76925	76988	77051	77114	77177	77240	77303	77366	77429	2	25
53	77492	77554	77617	77680	77742	77805	77867	77930	77992	78054	78117	78179	3	38
54	78241	78303	78365	78427	78489	78551	78613	78675	78737	78799	78861	78922	4	50
55	8.78984	79045	79107	79169	79230	79291	79353	79414	79475	79537	79598	79659	s	
56	79720	79781	79842	79903	79964	80025	80085	80146	80207	80268	80328	80389	1	12
57	80449	80510	80570	80631	80691	80751	80812	80872	80932	80992	81052	81112	2	24
58	81172	81232	81292	81352	81412	81472	81531	81591	81651	81710	81770	81829	3	36
59	81889	81948	82008	82067	82126	82186	82245	82304	82363	82422	82481	82540	4	48

TABLE XXXI.

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

2 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	8.82599	82658	82717	82776	82835	82893	82952	83011	83069	83128	83187	83245	s	
1	83303	83362	83420	83478	83537	83595	83653	83711	83769	83828	83885	83944	1	11
2	84001	84059	84117	84175	84233	84291	84348	84406	84464	84521	84579	84636	2	23
3	84694	84751	84808	84866	84923	84980	85037	85095	85152	85209	85266	85323	3	34
4	85380	85437	85494	85550	85607	85664	85721	85777	85834	85891	85947	86004	4	46
5	8.86060	86117	86173	86229	86286	86342	86398	86454	86511	86567	86623	86679	s	
6	86735	86791	86847	86903	86959	87014	87070	87126	87182	87237	87293	87348	1	11
7	87404	87460	87515	87570	87626	87681	87736	87792	87847	87902	87957	88013	2	22
8	88068	88123	88178	88233	88288	88342	88397	88452	88507	88562	88616	88671	3	33
9	88726	88780	88835	88889	88944	88998	89053	89107	89162	89216	89270	89324	4	44
10	8.89379	89433	89487	89541	89595	89649	89703	89757	89811	89865	89918	89972	s	
11	90026	90080	90133	90187	90241	90294	90348	90401	90455	90508	90562	90615	1	11
12	90668	90722	90775	90828	90881	90934	90988	91041	91094	91147	91200	91253	2	21
13	91306	91358	91411	91464	91517	91570	91622	91675	91728	91780	91833	91885	3	32
14	91938	91990	92043	92095	92147	92200	92252	92304	92356	92408	92461	92513	4	42
15	8.92565	92617	92669	92721	92773	92825	92877	92928	92980	93032	93084	93135	s	
16	93187	93239	93290	93342	93393	93445	93496	93548	93599	93651	93702	93753	1	10
17	93804	93856	93907	93958	94009	94060	94111	94162	94213	94264	94315	94366	2	20
18	94417	94468	94519	94570	94620	94671	94722	94772	94823	94874	94924	94975	3	31
19	95025	95075	95126	95176	95227	95277	95327	95378	95428	95478	95528	95578	4	41
20	8.95628	95678	95728	95778	95828	95878	95928	95978	96028	96078	96128	96178	s	
21	96227	96277	96326	96376	96426	96475	96525	96574	96624	96673	96723	96772	1	10
22	96821	96871	96920	96969	97018	97068	97117	97166	97215	97264	97313	97362	2	20
23	97411	97460	97509	97558	97607	97656	97704	97753	97802	97851	97899	97918	3	29
24	97996	98045	98094	98142	98191	98239	98288	98336	98384	98433	98481	98529	4	39
25	8.98578	98626	98674	98722	98770	98818	98866	98914	98963	99011	99058	99106	s	
26	99154	99202	99250	99298	99346	99393	99141	99489	99536	99584	99632	99679	1	10
27	$\frac{8}{9}$.99727	99774	99822	99869	99917	99964	00012	00059	00106	00154	00201	00248	2	19
28	9.00295	00342	00390	00437	00484	00531	00578	00625	00672	00719	00766	00813	3	29
29	00860	00906	00953	01000	01047	01094	01140	01187	01234	01280	01327	01373	4	38
30	9.01420	01466	01513	01559	01606	01652	01698	01745	01791	01837	01884	01930	s	
31	01976	02022	02068	02114	02161	02207	02253	02299	02345	02391	02437	02483	1	9
32	02528	02574	02620	02666	02712	02757	02803	02849	02894	02940	02986	03031	2	18
33	03077	03122	03168	03213	03259	03304	03350	03395	03440	03486	03531	03576	3	28
34	03621	03667	03712	03757	03802	03847	03892	03937	03982	04027	04072	04117	4	37
35	9.04162	04207	04252	04297	04341	04386	04431	04476	04520	04565	04610	04654	s	
36	04699	04744	04788	04833	04877	04922	04966	05011	05055	05099	05144	05188	1	9
37	05232	05277	05321	05365	05409	05453	05498	05542	05586	05630	05674	05718	2	18
38	05762	05806	05850	05894	05938	05982	06025	06069	06113	06157	06200	06244	3	27
39	06288	06332	06375	06419	06462	06506	06550	06593	06637	06680	06724	06767	4	36
40	9.06810	06854	06897	06940	06984	07027	07070	07113	07157	07200	07243	07286	s	
41	07329	07372	07415	07458	07501	07544	07587	07630	07673	07716	07759	07802	1	9
42	07845	07887	07930	07973	08016	08058	08101	08144	08186	08229	08271	08314	2	17
43	08357	08399	08442	08484	08526	08569	08611	08654	08696	08738	08781	08823	3	26
44	08865	08907	08949	08992	09034	09076	09118	09160	09202	09244	09286	09328	4	35
45	9 09370	09412	09454	09496	09538	09580	09622	09663	09705	09747	09789	09830	s	
46	09872	09914	09955	09997	10039	10080	10122	10163	10205	10246	10288	10329	1	8
47	10371	10412	10453	10495	10536	10577	10619	10660	10701	10742	10784	10825	2	17
48	10866	10907	10948	10989	11030	11071	11112	11153	11194	11235	11276	11317	3	25
49	11358	11399	11440	11480	11521	11562	11603	11643	11684	11725	11765	11806	4	34
50	9.11847	11887	11928	11968	12009	12050	12090	12130	12171	12211	12252	12292	s	
51	12332	12373	12113	12453	12494	12534	12574	12614	12655	12695	12735	12775	1	8
52	12815	12855	12895	12935	12975	13015	13055	13095	13135	13175	13215	13255	2	16
53	13295	13334	13374	13414	13454	13494	13533	13573	13613	13652	13692	13732	3	24
54	13771	13811	13850	13890	13929	13969	14008	14048	14087	14126	14166	14205	4	32
55	9.14245	14284	14323	14362	14402	14441	14480	14519	14559	14598	14637	14676	s	
56	14715	14754	14793	14832	14871	14910	14949	14988	15027	15066	15105	15144	1	8
57	15183	15221	15260	15299	15338	15377	15415	15454	15493	15531	15570	15609	2	15
58	15647	15686	15724	15763	15802	15840	15879	15917	15955	15994	16032	16071	3	23
59	16109	16147	16186	16224	16262	16301	16339	16377	16415	16453	16492	16530	4	30

TABLE XXXI.

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

3 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	9.16568	16606	16644	16682	16720	16758	16796	16834	16872	16910	16948	16986	s	
1	17024	17062	17100	17138	17175	17213	17251	17289	17326	17364	17402	17440	1	7
2	17477	17515	17553	17590	17628	17665	17703	17740	17778	17815	17853	17890	2	15
3	17928	17965	18003	18040	18077	18115	18152	18189	18227	18264	18301	18338	3	22
4	18376	18413	18450	18487	18524	18561	18598	18636	18673	18710	18747	18784	4	30
5	9.18821	18858	18895	18932	18968	19005	19042	19079	19116	19153	19190	19226	s	
6	19263	19300	19337	19373	19410	19447	19483	19520	19557	19593	19630	19666	1	7
7	19703	19739	19776	19812	19849	19885	19922	19958	19995	20031	20067	20104	2	14
8	20140	20176	20213	20249	20285	20321	20358	20394	20430	20466	20502	20538	3	22
9	20574	20611	20647	20683	20719	20755	20791	20827	20863	20899	20935	20970	4	29
10	9.21006	21042	21078	21114	21150	21186	21221	21257	21293	21329	21364	21400	s	
11	21436	21471	21507	21543	21578	21614	21650	21685	21721	21756	21792	21827	1	7
12	21863	21898	21934	21969	22004	22040	22075	22111	22146	22181	22216	22252	2	14
13	22287	22322	22358	22393	22428	22463	22498	22533	22569	22604	22639	22674	3	21
14	22709	22744	22779	22814	22849	22884	22919	22954	22989	23024	23059	23094	4	28
15	9.23128	23163	23198	23233	23268	23302	23337	23372	23407	23441	23476	23511	s	
16	23545	23580	23615	23649	23684	23718	23753	23788	23822	23857	23891	23926	1	7
17	23960	23994	24029	24063	24098	24132	24166	24201	24235	24269	24304	24338	2	14
18	24372	24406	24441	24475	24509	24543	24577	24612	24646	24680	24714	24748	3	20
19	24782	24816	24850	24884	24918	24952	24986	25020	25054	25088	25122	25156	4	27
20	9.25190	25224	25257	25291	25325	25359	25393	25426	25460	25494	25527	25561	s	
21	25595	25629	25662	25696	25729	25763	25796	25830	25864	25897	25931	25964	1	7
22	25998	26031	26065	26098	26132	26165	26198	26232	26265	26298	26332	26365	2	13
23	26398	26432	26465	26498	26532	26565	26598	26631	26664	26697	26731	26764	3	20
24	26797	26830	26863	26896	26929	26962	26995	27028	27061	27094	27127	27160	4	26
25	9.27193	27226	27259	27292	27325	27357	27390	27423	27456	27489	27521	27554	s	
26	27587	27620	27652	27685	27718	27751	27783	27816	27848	27881	27914	27946	1	6
27	27979	28011	28044	28076	28109	28141	28174	28206	28239	28271	28304	28336	2	13
28	28368	28401	28433	28465	28498	28530	28562	28595	28627	28659	28691	28724	3	19
29	28756	28788	28820	28852	28885	28917	28949	28981	29013	29045	29077	29109	4	26
30	9.29141	29173	29205	29237	29269	29301	29333	29365	29397	29429	29461	29493	s	
31	29524	29556	29588	29620	29652	29683	29715	29747	29779	29810	29842	29874	1	6
32	29905	29937	29969	30000	30032	30064	30095	30127	30158	30190	30221	30253	2	12
33	30285	30316	30347	30379	30410	30442	30473	30505	30536	30567	30599	30630	3	18
34	30661	30693	30724	30755	30787	30818	30849	30880	30912	30943	30974	31005	4	25
35	9.31036	31068	31099	31130	31161	31192	31223	31254	31285	31316	31347	31378	s	
36	31409	31440	31471	31502	31533	31564	31595	31626	31657	31688	31719	31749	1	6
37	31780	31811	31842	31873	31903	31934	31965	31996	32026	32057	32088	32119	2	12
38	32149	32180	32210	32241	32272	32302	32333	32363	32394	32425	32455	32486	3	18
39	32516	32547	32577	32608	32638	32668	32699	32729	32760	32790	32820	32851	4	24
40	9.32881	32911	32942	32972	33002	33033	33063	33093	33123	33154	33184	33214	s	
41	33244	33274	33304	33335	33365	33395	33425	33455	33485	33515	33545	33575	1	6
42	33605	33635	33665	33695	33725	33755	33785	33815	33845	33875	33905	33935	2	12
43	33965	33994	34024	34054	34084	34114	34143	34173	34203	34233	34262	34292	3	18
44	34322	34352	34381	34411	34441	34470	34500	34529	34559	34589	34618	34648	4	24
45	9.34677	34707	34736	34766	34795	34825	34854	34884	34913	34943	34972	35002	s	
46	35031	35060	35090	35119	35148	35178	35207	35236	35265	35295	35324	35353	1	6
47	35383	35412	35441	35470	35499	35529	35558	35587	35616	35645	35674	35703	2	12
48	35733	35762	35791	35820	35849	35878	35907	35936	35965	35994	36023	36052	3	17
49	36081	36110	36139	36167	36196	36225	36254	36283	36312	36341	36369	36398	4	23
50	9.36427	36456	36485	36513	36542	36571	36599	36628	36657	36686	36714	36743	s	
51	36771	36800	36829	36857	36886	36915	36943	36972	37000	37029	37057	37086	1	6
52	37114	37143	37171	37200	37228	37257	37285	37313	37342	37370	37399	37427	2	11
53	37455	37484	37512	37540	37568	37597	37625	37653	37682	37710	37738	37766	3	17
54	37794	37823	37851	37879	37907	37935	37963	37991	38020	38048	38076	38104	4	23
55	9.38132	38160	38188	38216	38244	38272	38300	38328	38356	38384	38412	38440	s	
56	38468	38496	38524	38551	38579	38607	38635	38663	38691	38718	38746	38774	1	6
57	38802	38830	38857	38885	38913	38940	38968	38996	39024	39051	39079	39107	2	11
58	39134	39162	39189	39217	39245	39272	39300	39327	39355	39382	39410	39437	3	17
59	39465	39492	39520	39547	39575	39602	39630	39657	39684	39712	39739	39767	4	22

TABLE XXXI.

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

4 Hours.

M	0^s	5^s	10^s	15^s	20^s	25^s	30^s	35^s	40^s	45^s	50^s	55^s	Pro. pts.	
0	9.39794	39821	39849	39876	39903	39931	39958	39985	40012	40040	40067	40094	s	
1	40121	40149	40176	40203	40230	40257	40284	40312	40339	40366	40393	40420	1	5
2	40447	40474	40501	40528	40555	40582	40609	40636	40663	40690	40717	40744	2	11
3	40771	40798	40825	40852	40879	40906	40933	40960	40986	41013	41040	41067	3	16
4	41094	41121	41147	41174	41201	41228	41254	41281	41308	41335	41361	41388	4	22
5	9.41415	41441	41468	41495	41521	41548	41575	41601	41628	41654	41681	41707	s	
6	41734	41761	41787	41814	41840	41867	41893	41920	41946	41972	41999	42025	1	5
7	42052	42078	42105	42131	42157	42184	42210	42236	42263	42289	42315	42342	2	10
8	42368	42394	42420	42447	42473	42499	42525	42552	42578	42604	42630	42656	3	16
9	42682	42709	42735	42761	42787	42813	42839	42865	42891	42917	42943	42969	4	21
10	9.42996	43022	43048	43074	43100	43125	43151	43177	43203	43229	43255	43281	s	
11	43307	43333	43359	43385	43411	43436	43462	43488	43514	43540	43565	43591	1	5
12	43617	43643	43669	43694	43720	43746	43771	43797	43823	43848	43874	43900	2	10
13	43925	43951	43977	44002	44028	44054	44079	44105	44130	44156	44181	44207	3	15
14	44232	44258	44283	44309	44334	44360	44385	44411	44436	44462	44487	44513	4	20
15	9.44538	44563	44589	44614	44639	44665	44690	44715	44741	44766	44791	44817	s	
16	44842	44867	44892	44918	44943	44968	44993	45019	45044	45069	45094	45119	1	5
17	45144	45170	45195	45220	45245	45270	45295	45320	45345	45370	45395	45420	2	10
18	45446	45471	45496	45521	45546	45571	45595	45620	45645	45670	45695	45720	3	15
19	45745	45770	45795	45820	45845	45870	45894	45919	45944	45969	45994	46018	4	20
20	9.46043	46068	46093	46118	46142	46167	46192	46217	46241	46266	46291	46315	s	
21	46340	46365	46389	46414	46439	46463	46488	46512	46537	46562	46586	46611	1	5
22	46635	46660	46684	46709	46733	46758	46782	46807	46831	46856	46880	46905	2	10
23	46929	46954	46978	47002	47027	47051	47076	47100	47124	47149	47173	47197	3	15
24	47222	47246	47270	47295	47319	47343	47367	47392	47416	47440	47464	47489	4	20
25	9.47513	47537	47561	47585	47610	47634	47658	47682	47706	47730	47754	47779	s	
26	47803	47827	47851	47875	47899	47923	47947	47971	47995	48019	48043	48067	1	5
27	48091	48115	48139	48163	48187	48211	48235	48258	48282	48306	48330	48354	2	10
28	48378	48402	48426	48449	48473	48497	48521	48545	48568	48592	48616	48640	3	14
29	48664	48687	48711	48735	48758	48782	48806	48830	48853	48877	48900	48924	4	19
30	9.48948	48971	48995	49019	49042	49066	49089	49113	49137	49160	49184	49207	s	
31	49231	49254	49278	49301	49325	49348	49372	49395	49419	49442	49465	49489	1	5
32	49512	49536	49559	49583	49606	49629	49653	49676	49699	49723	49746	49769	2	9
33	49793	49816	49839	49862	49886	49909	49932	49956	49979	50002	50025	50048	3	14
34	50071	50095	50118	50141	50164	50187	50211	50234	50257	50280	50303	50326	4	19
35	9.50349	50372	50395	50418	50441	50465	50488	50511	50534	50557	50580	50603	s	
36	50626	50649	50672	50694	50717	50740	50763	50786	50809	50832	50855	50878	1	5
37	50901	50924	50946	50969	50992	51015	51038	51060	51083	51106	51129	51152	2	9
38	51174	51197	51220	51243	51265	51288	51311	51334	51356	51379	51402	51424	3	14
39	51447	51470	51492	51515	51538	51560	51583	51605	51628	51651	51673	51696	4	18
40	9.51718	51741	51763	51786	51808	51831	51853	51876	51898	51921	51943	51966	s	
41	51988	52011	52033	52056	52078	52100	52123	52145	52168	52190	52212	52235	1	4
42	52257	52279	52302	52324	52346	52369	52391	52413	52435	52458	52480	52502	2	9
43	52525	52547	52569	52591	52613	52636	52658	52680	52702	52724	52747	52769	3	13
44	52791	52813	52835	52857	52879	52901	52923	52946	52968	52990	53012	53034	4	18
45	9.53056	53078	53100	53122	53144	53166	53188	53210	53232	53254	53276	53298	s	
46	53320	53342	53364	53385	53407	53429	53451	53473	53495	53517	53539	53560	1	4
47	53582	53604	53626	53648	53670	53691	53713	53735	53757	53778	53800	53822	2	9
48	53844	53865	53887	53909	53931	53952	53974	53996	54017	54039	54061	54082	3	13
49	54104	54126	54147	54169	54190	54212	54234	54255	54277	54298	54320	54341	4	18
50	9.54363	54385	54406	54428	54449	54471	54492	54514	54535	54556	54578	54599	s	
51	54621	54642	54664	54685	54707	54728	54749	54771	54792	54813	54835	54856	1	4
52	54878	54899	54920	54941	54963	54984	55005	55027	55048	55069	55091	55112	2	9
53	55133	55154	55175	55197	55218	55239	55260	55282	55303	55324	55345	55366	3	13
54	55387	55409	55430	55451	55472	55493	55514	55535	55556	55577	55598	55619	4	17
55	9.55641	55662	55683	55704	55725	55746	55767	55788	55809	55830	55851	55872	s	
56	55893	55914	55934	55955	55976	55997	56018	56039	56060	56081	56102	56123	1	4
57	56144	56164	56185	56206	56227	56248	56269	56289	56310	56331	56352	56372	2	8
58	56393	56414	56435	56456	56476	56497	56518	56538	56559	56580	56601	56621	3	13
59	56642	56663	56683	56704	56725	56745	56766	56786	56807	56828	56848	56869	4	17

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

5 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9.56889	56910	56931	56951	56972	56992	57013	57033	57054	57074	57095	57115	s	
1	57136	57156	57177	57197	57218	57238	57259	57279	57299	57320	57340	57361	1	4
2	57381	57402	57422	57442	57463	57483	57503	57524	57544	57564	57585	57605	2	8
3	57625	57646	57666	57686	57706	57727	57747	57767	57787	57808	57828	57848	3	12
4	57868	57889	57909	57929	57949	57969	57990	58010	58030	58050	58070	58090	4	16
5	9.58110	58131	58151	58171	58191	58211	58231	58251	58271	58291	58311	58331	s	
6	58351	58371	58391	58411	58431	58451	58471	58491	58511	58531	58551	58571	1	4
7	58591	58611	58631	58651	58671	58691	58711	58731	58750	58770	58790	58810	2	8
8	58830	58850	58870	58889	58909	58929	58949	58969	58988	59008	59028	59048	3	12
9	59068	59087	59107	59127	59147	59166	59186	59206	59225	59245	59265	59285	4	16
10	9.59304	59324	59344	59363	59383	59403	59422	59442	59461	59481	59501	59520	s	
11	59540	59559	59579	59599	59618	59638	59657	59677	59696	59716	59735	59755	1	4
12	59774	59794	59813	59833	59852	59872	59891	59911	59930	59950	59969	59988	2	8
13	60008	60027	60047	60066	60085	60105	60124	60144	60163	60182	60202	60221	3	12
14	60240	60260	60279	60298	60318	60337	60356	60375	60395	60414	60433	60452	4	16
15	9.60472	60491	60510	60529	60549	60568	60587	60606	60625	60645	60664	60683	s	
16	60702	60721	60740	60760	60779	60798	60817	60836	60855	60874	60893	60912	1	4
17	60931	60951	60970	60989	61008	61027	61046	61065	61084	61103	61122	61141	2	8
18	61160	61179	61198	61217	61236	61255	61274	61293	61311	61330	61349	61368	3	11
19	61387	61406	61425	61444	61463	61482	61500	61519	61538	61557	61576	61595	4	15
20	9.61613	61632	61651	61670	61689	61708	61726	61745	61764	61783	61801	61820	s	
21	61839	61858	61876	61895	61914	61932	61951	61970	61988	62007	62026	62045	1	4
22	62063	62082	62100	62119	62138	62156	62175	62194	62212	62231	62249	62268	2	7
23	62287	62305	62324	62342	62361	62379	62398	62416	62435	62453	62472	62490	3	11
24	62509	62527	62546	62564	62583	62601	62620	62638	62657	62675	62693	62712	4	15
25	9.62730	62749	62767	62785	62804	62822	62841	62859	62877	62896	62914	62932	s	
26	62951	62969	62987	63006	63024	63042	63061	63079	63097	63115	63134	63152	1	4
27	63170	63188	63207	63225	63243	63261	63279	63298	63316	63334	63352	63370	2	7
28	63389	63407	63425	63443	63461	63479	63497	63516	63534	63552	63570	63588	3	11
29	63606	63624	63642	63660	63678	63696	63715	63733	63751	63769	63787	63805	4	15
30	9.63823	63841	63859	63877	63895	63913	63931	63949	63966	63985	64002	64020	s	
31	64038	64056	64074	64092	64110	64128	64146	64164	64181	64199	64217	64235	1	4
32	64253	64271	64289	64307	64324	64342	64360	64378	64395	64413	64431	64449	2	7
33	64467	64484	64502	64520	64538	64555	64573	64591	64609	64626	64644	64662	3	11
34	64679	64697	64715	64732	64750	64768	64785	64803	64821	64838	64856	64873	4	14
35	9.64891	64909	64926	64944	64962	64979	64997	65014	65032	65050	65067	65085	s	
36	65102	65120	65137	65155	65172	65190	65207	65225	65242	65260	65277	65295	1	3
37	65312	65330	65347	65365	65382	65399	65417	65434	65452	65469	65486	65504	2	7
38	65521	65539	65556	65573	65591	65608	65625	65643	65660	65677	65695	65712	3	10
39	65729	65747	65764	65781	65799	65816	65834	65850	65868	65885	65902	65919	4	14
40	9.65937	65954	65971	65988	66006	66023	66040	66057	66074	66092	66109	66126	s	
41	66143	66160	66177	66194	66212	66229	66246	66263	66280	66297	66314	66331	1	3
42	66348	66366	66383	66400	66417	66434	66451	66468	66485	66502	66519	66536	2	7
43	66553	66570	66587	66604	66621	66638	66655	66672	66689	66706	66723	66740	3	10
44	66757	66774	66791	66807	66824	66841	66858	66875	66892	66909	66926	66943	4	14
45	9.66959	66976	66993	67010	67027	67044	67060	67077	67094	67111	67128	67144	s	
46	67161	67178	67195	67212	67228	67245	67262	67279	67295	67312	67329	67346	1	3
47	67362	67379	67396	67412	67429	67446	67462	67479	67496	67512	67529	67546	2	7
48	67562	67579	67596	67612	67629	67646	67662	67679	67695	67712	67729	67745	3	10
49	67762	67778	67795	67811	67828	67844	67861	67878	67894	67911	67927	67944	4	13
50	9.67960	67977	67993	68010	68026	68042	68059	68075	68092	68108	68125	68141	s	
51	68158	68174	68190	68207	68223	68240	68256	68272	68289	68305	68322	68338	1	3
52	68354	68371	68387	68403	68420	68436	68452	68469	68485	68501	68517	68534	2	7
53	68550	68566	68583	68599	68615	68631	68648	68664	68680	68696	68713	68729	3	10
54	68745	68761	68777	68794	68810	68826	68842	68858	68874	68891	68907	68923	4	13
55	9.68939	68955	68971	68987	69004	69020	69036	69052	69068	69084	69100	69116	s	
56	69132	69148	69164	69181	69197	69213	69229	69245	69261	69277	69293	69309	1	3
57	69325	69341	69357	69373	69389	69405	69421	69437	69453	69469	69484	69500	2	6
58	69516	69532	69548	69564	69580	69596	69612	69628	69644	69660	69675	69691	3	10
59	69707	69723	69739	69755	69770	69786	69802	69818	69834	69850	69866	69881	4	13

TABLE XXXI

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

6 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9.69897	69913	69929	69944	69960	69976	69992	70007	70023	70039	70055	70070	s	
1	70086	70102	70118	70133	70149	70165	7018	70196	70211	70227	70243	70259	1	3
2	70274	70290	70306	70321	70337	70353	70368	70384	70399	70415	70431	70446	2	6
3	70462	70477	70493	70509	70524	70540	70555	70571	70586	70602	70617	70633	3	9
4	70648	70664	70680	70695	70710	70726	70741	70757	70772	70788	70803	70819	4	12
5	9.70834	70850	70865	70881	70896	70911	70927	70942	70958	70973	70988	71004	s	
6	71019	71035	71050	71065	71081	71096	71111	71127	71142	71157	71173	71188	1	3
7	71203	71219	71234	71249	71265	71280	71295	71310	71326	71341	71356	71371	2	6
8	71387	71402	71417	71433	71448	71463	71478	71493	71509	71524	71539	71554	3	9
9	71569	71585	71600	71615	71630	71645	71660	71676	71691	71706	71721	71736	4	12
10	9.71751	71766	71781	71797	71812	71827	71842	71857	71872	71887	71902	71917	s	
11	71932	71947	71962	71977	71992	72007	72022	72037	72052	72067	72082	72097	1	3
12	72112	72127	72142	72157	72172	72187	72202	72217	72232	72247	72262	72277	2	6
13	72292	72307	72322	72337	72352	72366	72381	72396	72411	72426	72441	72456	3	9
14	72471	72485	72500	72515	72530	72545	72560	72574	72589	72604	72619	72634	4	12
15	9.72648	72663	72678	72693	72708	72722	72737	72752	72767	72781	72796	72811	s	
16	72825	72840	72855	72870	72884	72899	72914	72928	72943	72958	72972	72987	1	3
17	73002	73016	73031	73046	73060	73075	73090	73104	73119	73134	73148	73163	2	6
18	73177	73192	73207	73221	73236	73250	73265	73279	73294	73309	73323	73338	3	9
19	73352	73367	73381	73396	73410	73425	73439	73454	73468	73483	73497	73512	4	12
20	9.73526	73541	73555	73569	73584	73598	73613	73627	73642	73656	73671	73685	s	
21	73699	73714	73728	73743	73757	73771	73786	73800	73815	73829	73843	73858	1	3
22	73872	73886	73901	73915	73929	73944	73958	73972	73987	74001	74015	74029	2	6
23	74044	74058	74072	74087	74101	74115	74129	74144	74158	74172	74186	74200	3	9
24	74215	74229	74243	74257	74272	74286	74300	74314	74328	74342	74357	74371	4	12
25	9.74385	74399	74413	74427	74442	74456	74470	74484	74498	74512	74526	74540	s	
26	74554	74569	74583	74597	74611	74625	74639	74653	74667	74681	74695	74709	1	3
27	74723	74737	74751	74765	74779	74793	74807	74821	74835	74849	74863	74877	2	5
28	74891	74905	74919	74933	74947	74961	74975	74989	75003	75017	75031	75045	3	8
29	75059	75072	75086	75100	75114	75128	75142	75156	75170	75183	75197	75211	4	11
30	9.75225	75239	75253	75267	75280	75294	75308	75322	75336	75349	75363	75377	s	
31	75391	75405	75418	75432	75446	75460	75474	75487	75501	75515	75528	75542	1	3
32	75556	75570	75583	75597	75611	75625	75638	75652	75666	75679	75693	75707	2	5
33	75720	75734	75748	75761	75775	75789	75802	75816	75830	75843	75857	75870	3	8
34	75884	75898	75911	75925	75938	75952	75966	75979	75993	76006	76020	76033	4	10
35	9.76047	76060	76074	76088	76101	76115	76128	76142	76155	76169	76182	76196	s	
36	76209	76223	76236	76250	76263	76276	76290	76303	76317	76330	76344	76357	1	3
37	76371	76384	76397	76411	76424	76438	76451	76464	76478	76491	76505	76518	2	5
38	76531	76545	76558	76571	76585	76598	76611	76625	76638	76651	76665	76678	3	8
39	76691	76705	76718	76731	76745	76758	76771	76784	76798	76811	76824	76838	4	10
40	9.76851	76864	76877	76891	76904	76917	76930	76943	76957	76970	76983	76996	s	
41	77009	77023	77036	77049	77062	77075	77089	77102	77115	77128	77141	77154	1	3
42	77167	77181	77194	77207	77220	77233	77246	77259	77272	77285	77298	77312	2	5
43	77325	77338	77351	77364	77377	77390	77403	77416	77429	77442	77455	77468	3	8
44	77481	77494	77507	77520	77533	77546	77559	77572	77585	77598	77611	77624	4	10
45	9.77637	77650	77663	77676	77689	77702	77715	77728	77741	77754	77766	77779	s	
46	77792	77805	77818	77831	77844	77857	77870	77882	77895	77908	77921	77934	1	3
47	77947	77960	77972	77985	77998	78011	78024	78037	78049	78062	78075	78088	2	5
48	78101	78113	78126	78139	78152	78164	78177	78190	78203	78215	78228	78241	3	8
49	78254	78266	78279	78292	78305	78317	78330	78343	78355	78368	78381	78393	4	10
50	9.78406	78419	78431	78444	78457	78469	78482	78495	78507	78520	78533	78545	s	
51	78558	78570	78583	78596	78608	78621	78633	78646	78659	78671	78684	78696	1	2
52	78709	78721	78734	78747	78759	78772	78784	78797	78809	78822	78834	78847	2	5
53	78859	78872	78884	78897	78909	78922	78934	78947	78959	78972	78984	78997	3	7
54	79009	79021	79034	79046	79059	79071	79084	79096	79108	79121	79133	79146	4	10
55	9.79158	79170	79183	79195	79208	79220	79232	79245	79257	79269	79282	79294	s	
56	79306	79319	79331	79343	79356	79368	79380	79393	79405	79417	79430	79442	1	2
57	79454	79466	79479	79491	79503	79515	79528	79540	79552	79564	79577	79589	2	5
58	79601	79613	79626	79638	79650	79662	79674	79687	79699	79711	79723	79735	3	7
59	79748	79760	79772	79784	79796	79808	79821	79833	79845	79857	79869	79881	4	10

TABLE XXXI.

LOGARITHMS for finding the APPARENT TIME or HORARY ANGLE.

7 Hours.

M	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9.79893	79905	79918	79930	79942	79954	79966	79978	79990	80002	80014	80026	s	
1	80038	80050	80063	80075	80087	80099	80111	80123	80135	80147	80159	80171	1	2
2	80183	80195	80207	80219	80231	80243	80255	80267	80279	80291	80303	80315	2	5
3	80327	80338	80350	80362	80374	80386	80398	80410	80422	80434	80446	80458	3	7
4	80470	80482	80494	80505	80517	80529	80541	80553	80565	80577	80588	80600	4	9
5	9.80612	80624	80636	80648	80660	80671	80683	80695	80707	80719	80730	80742	s	
6	80754	80766	80778	80789	80801	80813	80825	80836	80848	80860	80872	80883	1	2
7	80895	80907	80919	80930	80942	80954	80966	80977	80989	81001	81012	81024	2	5
8	81036	81047	81059	81071	81082	81094	81106	81117	81129	81141	81152	81164	3	7
9	81176	81187	81199	81211	81222	81234	81245	81257	81269	81280	81292	81303	4	9
10	9.81315	81326	81338	81350	81361	81373	81384	81396	81407	81419	81430	81442	s	
11	81454	81465	81477	81488	81500	81511	81523	81534	81546	81557	81569	81580	1	2
12	81592	81603	81614	81626	81637	81649	81660	81672	81683	81695	81706	81717	2	5
13	81729	81740	81752	81763	81775	81786	81797	81809	81820	81831	81843	81854	3	7
14	81866	81877	81888	81900	81911	81922	81934	81945	81956	81968	81979	81990	4	9
15	9.82002	82013	82024	82036	82047	82058	82070	82081	82092	82103	82115	82126	s	
16	82137	82148	82160	82171	82182	82193	82205	82216	82227	82238	82250	82261	1	2
17	82272	82283	82294	82306	82317	82328	82339	82350	82362	82373	82384	82395	2	4
18	82406	82417	82429	82440	82451	82462	82473	82484	82495	82507	82518	82529	3	7
19	82540	82551	82562	82573	82584	82595	82606	82618	82629	82640	82651	82662	4	9
20	9.82673	82684	82695	82706	82717	82728	82739	82750	82761	82772	82783	82794	s	
21	82805	82816	82827	82838	82849	82860	82871	82882	82893	82904	82915	82926	1	2
22	82937	82948	82959	82970	82981	82992	83003	83014	83025	83035	83046	83057	2	4
23	83068	83079	83090	83101	83112	83123	83134	83144	83155	83166	83177	83188	3	7
24	83199	83210	83220	83231	83242	83253	83264	83275	83285	83296	83307	83318	4	9
25	9.83329	83339	83350	83361	83372	83383	83393	83404	83415	83426	83436	83447	s	
26	83458	83469	83479	83490	83501	83512	83522	83533	83544	83555	83565	83576	1	2
27	83587	83597	83608	83619	83629	83640	83651	83662	83672	83683	83694	83704	2	4
28	83715	83725	83736	83747	83757	83768	83779	83789	83800	83811	83821	83832	3	7
29	83842	83853	83864	83874	83885	83895	83906	83916	83927	83938	83948	83959	4	9
30	9.83969	83980	83990	84001	84011	84022	84033	84043	84054	84064	84075	84085	s	
31	84096	84106	84117	84127	84138	84148	84159	84169	84179	84190	84200	84211	1	2
32	84221	84232	84242	84253	84263	84274	84284	84294	84305	84315	84326	84336	2	4
33	84346	84357	84367	84378	84388	84398	84409	84119	84430	84440	84450	84461	3	6
34	84471	84481	84492	84502	84512	84523	84533	84543	84554	84561	84574	84585	4	8
35	9.84595	84605	84616	84626	84636	84646	84657	84667	84677	84687	84698	84708	s	
36	84718	84729	84739	84749	84759	84769	84780	84790	84800	84810	84821	84831	1	2
37	84841	84851	84861	84872	84882	84892	84902	84912	84923	84933	84943	84953	2	4
38	84963	84973	84984	84994	85004	85014	85024	85034	85044	85054	85065	85075	3	6
39	85085	85095	85105	85115	85125	85135	85145	85155	85166	85176	85186	85196	4	8
40	9.85206	85216	85226	85236	85246	85256	85266	85276	85286	85296	85306	85316	s	
41	85326	85336	85346	85356	85366	85376	85386	85396	85406	85416	85426	85436	1	2
42	85446	85456	85466	85476	85486	85496	85506	85516	85526	85536	85546	85555	2	4
43	85565	85575	85585	85595	85605	85615	85625	85635	85645	85654	85664	85674	3	6
44	85684	85694	85704	85714	85724	85733	85743	85753	85763	85773	85783	85792	4	8
45	9.85802	85812	85822	85832	85841	85851	85861	85871	85881	85890	85900	85910	s	
46	85920	85930	85939	85949	85959	85969	85978	85988	85998	86008	86017	86027	1	2
47	86037	86046	86056	86066	86076	86085	86095	86105	86114	86124	86134	86143	2	4
48	86153	86163	86172	86182	86192	86201	86211	86221	86230	86240	86250	86259	3	6
49	86269	86279	86288	86298	86307	86317	86327	86336	86346	86356	86365	86375	4	8
50	9.86384	86394	86403	86413	86423	86432	86442	86451	86461	86470	86480	86489	s	
51	86499	86509	86518	86528	86537	86547	86556	86566	86575	86585	86594	86604	1	2
52	86613	86623	86632	86642	86651	86661	86670	86679	86689	86698	86708	86717	2	4
53	86727	86736	86746	86755	86764	86774	86783	86793	86802	86812	86821	86830	3	6
54	86840	86849	86858	86868	86877	86887	86896	86905	86915	86924	86933	86943	4	8
55	9.86952	86962	86971	86980	86990	86999	87008	87018	87027	87036	87045	87055	s	
56	87064	87073	87083	87092	87101	87111	87120	87129	87138	87148	87157	87166	1	2
57	87175	87185	87194	87203	87212	87222	87231	87240	87249	87259	87268	87277	2	4
58	87286	87295	87305	87314	87323	87332	87341	87351	87360	87369	87378	87387	3	6
59	87396	87406	87415	87424	87433	87442	87451	87460	87470	87479	87488	87497	4	8

TABLE XXXII.

LOGARITHMS for finding the APPARENT TIME, or HORARY ANGLE.

8 Hours.

M.	0s	5s	10s	15s	20s	25s	30s	35s	40s	45s	50s	55s	Pro. pts.	
0	9.87506	87515	87524	87534	87543	87552	87561	87570	87579	87588	87597	87606	s	
1	87615	87624	87633	87643	87652	87661	87670	87679	87688	87697	87706	87715	1	2
2	87724	87733	87742	87751	87760	87769	87778	87787	87796	87805	87814	87823	2	4
3	87832	87841	87850	87859	87868	87877	87886	87895	87904	87913	87921	87930	3	5
4	87939	87948	87957	87966	87975	87984	87993	88002	88011	88020	88029	88038	4	7
5	9.88046	88055	88064	88073	88082	88091	88100	88109	88117	88126	88135	88144	s	
6	88153	88162	88170	88179	88188	88197	88206	88215	88223	88232	88241	88250	1	2
7	88259	88268	88276	88285	88294	88303	88311	88320	88329	88338	88346	88355	2	4
8	88364	88373	88381	88390	88399	88408	88416	88425	88434	88443	88451	88460	3	5
9	88469	88478	88486	88495	88503	88512	88521	88530	88538	88547	88556	88565	4	7
10	9.88573	88582	88590	88599	88607	88616	88625	88634	88642	88651	88659	88668	s	
11	88677	88686	88694	88703	88711	88720	88728	88737	88745	88754	88763	88772	1	2
12	88780	88789	88797	88806	88814	88823	88831	88840	88848	88857	88865	88874	2	4
13	88882	88891	88899	88908	88916	88925	88933	88942	88950	88959	88967	88976	3	5
14	88984	88993	89001	89010	89018	89027	89035	89044	89052	89061	89069	89078	4	7
15	9.89086	89095	89103	89112	89120	89129	89137	89145	89153	89162	89170	89179	s	
16	89187	89196	89204	89213	89221	89229	89237	89246	89254	89263	89271	89279	1	2
17	89287	89296	89304	89313	89321	89330	89338	89346	89354	89363	89371	89379	2	4
18	89387	89396	89404	89413	89421	89429	89437	89446	89454	89462	89470	89479	3	5
19	89487	89495	89503	89512	89520	89528	89536	89545	89553	89561	89569	89577	4	7
20	9.89586	89594	89602	89611	89619	89627	89635	89643	89651	89660	89668	89676	s	
21	89684	89693	89701	89709	89717	89725	89733	89741	89749	89758	89766	89774	1	2
22	89782	89790	89798	89807	89815	89823	89831	89839	89847	89855	89863	89871	2	3
23	89879	89888	89896	89904	89912	89920	89928	89936	89944	89952	89960	89968	3	5
24	89976	89984	89992	90000	90008	90016	90024	90032	90040	90048	90056	90064	4	6
25	9.90072	90080	90088	90096	90104	90112	90120	90128	90136	90144	90152	90160	s	
26	90168	90176	90184	90192	90200	90208	90216	90224	90232	90240	90248	90256	1	2
27	90263	90271	90279	90287	90295	90303	90311	90319	90327	90335	90342	90350	2	3
28	90358	90366	90374	90382	90390	90398	90405	90413	90421	90429	90437	90445	3	5
29	90452	90460	90468	90476	90484	90492	90499	90507	90515	90523	90531	90539	4	6
30	9.90546	90554	90562	90570	90577	90585	90593	90601	90608	90616	90624	90632	s	
31	90639	90647	90655	90663	90670	90678	90686	90694	90701	90709	90717	90725	1	2
32	90732	90740	90747	90755	90763	90771	90778	90786	90794	90802	90809	90817	2	3
33	90824	90832	90840	90848	90855	90863	90870	90878	90885	90893	90901	90909	3	5
34	90916	90924	90931	90939	90946	90954	90962	90970	90977	90985	90992	91000	4	6
35	9.91007	91015	91022	91030	91037	91045	91052	91060	91067	91075	91083	91091	s	
36	91098	91106	91113	91121	91128	91136	91143	91151	91158	91166	91173	91181	1	2
37	91188	91196	91203	91211	91218	91226	91233	91241	91248	91255	91262	91270	2	3
38	91277	91285	91292	91300	91307	91315	91322	91330	91337	91345	91352	91360	3	5
39	91367	91374	91381	91389	91396	91404	91411	91419	91426	91433	91440	91448	4	6
40	9.91455	91463	91470	91478	91485	91492	91499	91507	91514	91522	91529	91536	s	
41	91543	91551	91558	91566	91573	91580	91587	91595	91602	91609	91616	91624	1	2
42	91631	91638	91645	91653	91660	91667	91674	91682	91689	91696	91703	91711	2	3
43	91718	91725	91732	91740	91747	91754	91761	91769	91776	91783	91790	91798	3	5
44	91805	91812	91819	91826	91833	91841	91848	91855	91862	91869	91876	91884	4	6
45	9.91891	91898	91905	91912	91919	91927	91934	91941	91948	91955	91962	91969	s	
46	91976	91984	91991	91998	92005	92012	92019	92026	92033	92040	92047	92054	1	1
47	92061	92069	92076	92083	92090	92097	92104	92111	92118	92125	92132	92139	2	3
48	92146	92153	92160	92167	92174	92181	92188	92195	92202	92209	92216	92223	3	4
49	92230	92237	92244	92251	92258	92265	92272	92279	92286	92293	92300	92307	4	6
50	9.92314	92321	92328	92335	92342	92349	92355	92362	92369	92376	92383	92390	s	
51	92397	92404	92411	92418	92425	92432	92438	92445	92452	92459	92466	92473	1	1
52	92480	92487	92493	92500	92507	92514	92521	92528	92534	92541	92548	92555	2	3
53	92562	92569	92575	92582	92589	92596	92603	92610	92616	92623	92630	92637	3	4
54	92643	92650	92657	92664	92670	92677	92684	92691	92698	92705	92711	92718	4	6
55	9.92725	92732	92738	92745	92751	92758	92765	92772	92778	92785	92792	92799	s	
56	92805	92812	92819	92826	92832	92839	92845	92852	92859	92866	92872	92879	1	1
57	92885	92892	92899	92906	92912	92919	92925	92932	92939	92946	92952	92959	2	3
58	92965	92972	92978	92985	92992	92999	93005	93012	93018	93025	93031	93038	3	4
59	93044	93051	93057	93064	93071	93078	93084	93091	93097	93104	93110	93117	4	6

TABLE XXXIII.

LOGARITHMS for finding the correction to reduce the SUN's Declination, Right Ascension, &c. to any time under the Meridian of Greenwich.

Min or Sec.	HOURS, DEGREES, OR MINUTES.												Min. or Sec.
	0	1	2	3	4	5	6	7	8	9	10	11	
0		1.3802	1.0792	9031	7781	6812	6021	5351	4771	4260	3802	3388	0
1	3.1584	1.3730	1.0756	9007	7763	6798	6009	5341	4762	4252	3795	3382	1
2	2.8573	1.3660	1.0720	8983	7745	6784	5997	5330	4753	4244	3788	3375	2
3	2.6812	1.3590	1.0685	8959	7728	6769	5985	5320	4744	4236	3780	3368	3
4	2.5563	1.3522	1.0649	8935	7710	6755	5973	5309	4735	4228	3773	3362	4
5	2.4594	1.3454	1.0614	8912	7692	6741	5961	5300	4726	4220	3766	3355	5
6	2.3802	1.3388	1.0580	8888	7674	6726	5949	5289	4717	4212	3759	3349	6
7	2.3133	1.3323	1.0546	8865	7657	6712	5937	5279	4708	4204	3752	3342	7
8	2.2553	1.3259	1.0512	8842	7639	6698	5925	5269	4699	4196	3745	3336	8
9	2.2041	1.3195	1.0478	8819	7622	6684	5913	5259	4690	4188	3737	3329	9
10	2.1584	1.3133	1.0444	8796	7604	6670	5902	5249	4682	4180	3730	3323	10
11	2.1170	1.3071	1.0411	8773	7587	6656	5890	5239	4673	4172	3723	3316	11
12	2.0792	1.3010	1.0378	8751	7570	6642	5878	5229	4664	4164	3716	3310	12
13	2.0444	1.2950	1.0345	8728	7552	6628	5866	5219	4655	4156	3709	3303	13
14	2.0122	1.2891	1.0313	8706	7535	6614	5855	5209	4646	4148	3702	3297	14
15	1.9823	1.2833	1.0280	8683	7518	6600	5843	5199	4638	4141	3695	3291	15
16	1.9542	1.2775	1.0248	8661	7501	6587	5832	5189	4629	4133	3688	3284	16
17	1.9279	1.2719	1.0216	8639	7484	6573	5820	5179	4620	4125	3681	3278	17
18	1.9031	1.2663	1.0185	8617	7467	6559	5809	5169	4611	4117	3674	3271	18
19	1.8796	1.2607	1.0153	8595	7451	6546	5797	5159	4603	4109	3667	3265	19
20	1.8573	1.2553	1.0122	8573	7434	6532	5786	5149	4594	4102	3660	3258	20
21	1.8361	1.2499	1.0091	8552	7417	6518	5774	5139	4585	4094	3653	3252	21
22	1.8159	1.2445	1.0061	8530	7401	6505	5763	5129	4577	4086	3646	3246	22
23	1.7966	1.2393	1.0030	8509	7384	6492	5752	5120	4568	4079	3639	3239	23
24	1.7782	1.2341	1.0000	8487	7368	6478	5740	5110	4559	4071	3632	3233	24
25	1.7604	1.2289	0.9970	8466	7351	6465	5729	5100	4551	4063	3625	3227	25
26	1.7434	1.2239	0.9940	8445	7335	6451	5718	5090	4542	4055	3618	3220	26
27	1.7270	1.2188	0.9910	8424	7318	6438	5706	5081	4534	4048	3611	3214	27
28	1.7112	1.2139	0.9881	8403	7302	6425	5695	5071	4525	4040	3604	3208	28
29	1.6960	1.2090	0.9852	8382	7286	6412	5684	5061	4516	4032	3597	3201	29
30	1.6812	1.2041	0.9823	8361	7270	6398	5673	5051	4508	4025	3590	3195	30
31	1.6670	1.1993	0.9794	8341	7254	6385	5662	5042	4499	4017	3583	3189	31
32	1.6532	1.1946	0.9765	8320	7238	6372	5651	5032	4491	4010	3576	3183	32
33	1.6398	1.1899	0.9737	8300	7222	6359	5640	5023	4482	4002	3570	3176	33
34	1.6269	1.1852	0.9708	8279	7206	6346	5629	5013	4474	3994	3563	3170	34
35	1.6143	1.1806	0.9680	8259	7190	6333	5618	5003	4466	3987	3556	3161	35
36	1.6021	1.1761	0.9652	8239	7174	6320	5607	4994	4457	3979	3549	3157	36
37	1.5902	1.1716	0.9625	8219	7159	6307	5596	4984	4149	3972	3542	3151	37
38	1.5786	1.1671	0.9597	8199	7143	6294	5585	4975	4440	3961	3535	3145	38
39	1.5673	1.1627	0.9570	8179	7128	6282	5574	4965	4432	3957	3529	3139	39
40	1.5563	1.1584	0.9542	8159	7112	6269	5563	4956	4424	3949	3522	3133	40
41	1.5456	1.1540	0.9515	8140	7097	6256	5552	4947	4415	3942	3515	3126	41
42	1.5351	1.1498	0.9488	8120	7081	6243	5541	4937	4407	3934	3508	3120	42
43	1.5249	1.1455	0.9462	8101	7066	6231	5531	4928	4399	3927	3501	3114	43
44	1.5149	1.1413	0.9435	8081	7050	6218	5520	4918	4390	3919	3495	3108	44
45	1.5051	1.1372	0.9408	8062	7035	6205	5509	4909	4382	3912	3188	3102	45
46	1.4956	1.1331	0.9382	8043	7020	6193	5498	4900	4374	3905	3481	3096	46
47	1.4863	1.1290	0.9356	8023	7005	6180	5488	4890	4365	3897	3475	3089	47
48	1.4771	1.1249	0.9330	8004	6990	6168	5477	4881	4357	3890	3468	3083	48
49	1.4682	1.1209	0.9305	7985	6975	6155	5466	4872	4349	3882	3461	3077	49
50	1.4594	1.1170	0.9279	7966	6960	6143	5456	4863	4341	3875	3454	3071	50
51	1.4508	1.1130	0.9254	7947	6945	6131	5445	4853	4333	3868	3448	3065	51
52	1.4424	1.1091	0.9228	7929	6930	6118	5435	4844	4324	3860	3441	3059	52
53	1.4341	1.1053	0.9203	7910	6915	6106	5424	4835	4316	3853	3434	3053	53
54	1.4260	1.1015	0.9178	7891	6900	6094	5414	4826	4308	3846	3428	3047	54
55	1.4180	1.0977	0.9153	7873	6885	6081	5403	4817	4300	3838	3421	3041	55
56	1.4102	1.0940	0.9128	7854	6871	6069	5393	4808	4292	3831	3415	3034	56
57	1.4025	1.0902	0.9104	7836	6856	6057	5382	4798	4284	3824	3408	3028	57
58	1.3949	1.0865	0.9079	7818	6841	6045	5372	4789	4276	3817	3401	3022	58
59	1.3875	1.0828	0.9055	7800	6827	6033	5361	4780	4268	3809	3395	3016	59
	0	1	2	3	4	5	6	7	8	9	10	11	

TABLE XXXIII.

LOGARITHMS for finding the correction to reduce the SUN'S Declination, Right Ascension, &c. to any time under the Meridian of Greenwich.

Min. or Sec.	HOURS, DEGREES, OR MINUTES.												Min. or Sec.
	12	13	14	15	16	17	18	19	20	21	22	23	
0	3010	2663	2341	2041	1761	1498	1249	1015	0792	0580	0378	0185	0
1	3004	2657	2336	2036	1756	1493	1245	1011	0788	0576	0375	0182	1
2	2998	2652	2330	2031	1752	1489	1241	1007	0785	0573	0371	0179	2
3	2992	2646	2325	2027	1747	1485	1237	1003	0781	0570	0368	0175	3
4	2986	2640	2320	2022	1743	1481	1233	0999	0777	0566	0365	0172	4
5	2980	2635	2315	2017	1738	1476	1229	0996	0774	0563	0361	0169	5
6	2974	2629	2310	2012	1734	1472	1225	0992	0770	0559	0358	0166	6
7	2968	2624	2305	2008	1729	1468	1221	0988	0767	0556	0355	0163	7
8	2962	2618	2300	2003	1725	1464	1217	0984	0763	0552	0352	0160	8
9	2956	2613	2295	1998	1720	1459	1213	0980	0759	0549	0348	0157	9
10	2950	2607	2289	1993	1716	1455	1209	0977	0756	0546	0345	0153	10
11	2944	2602	2284	1988	1711	1451	1205	0973	0753	0542	0342	0150	11
12	2938	2596	2279	1984	1707	1447	1201	0969	0749	0539	0339	0147	12
13	2933	2591	2274	1979	1702	1443	1197	0965	0745	0535	0335	0144	13
14	2927	2585	2269	1974	1698	1438	1193	0962	0741	0532	0332	0141	14
15	2921	2580	2264	1969	1694	1434	1189	0958	0738	0528	0329	0138	15
16	2915	2574	2259	1965	1689	1430	1185	0954	0734	0525	0326	0135	16
17	2909	2569	2254	1960	1685	1426	1181	0950	0731	0522	0322	0132	17
18	2903	2564	2249	1955	1680	1422	1178	0947	0727	0518	0319	0128	18
19	2897	2558	2244	1950	1676	1417	1174	0943	0724	0515	0316	0125	19
20	2891	2553	2239	1946	1671	1413	1170	0939	0720	0511	0313	0122	20
21	2885	2547	2234	1941	1667	1409	1166	0935	0716	0508	0309	0119	21
22	2880	2542	2229	1936	1662	1405	1162	0932	0713	0505	0306	0116	22
23	2874	2536	2223	1932	1658	1401	1158	0928	0709	0501	0303	0113	23
24	2868	2531	2218	1927	1654	1397	1154	0924	0706	0498	0300	0110	24
25	2862	2526	2213	1922	1649	1392	1150	0920	0702	0495	0296	0107	25
26	2856	2520	2208	1917	1645	1388	1146	0917	0699	0491	0293	0104	26
27	2850	2515	2203	1913	1640	1384	1142	0913	0695	0488	0290	0101	27
28	2845	2510	2198	1908	1636	1380	1138	0909	0692	0484	0287	0098	28
29	2839	2504	2193	1903	1632	1376	1134	0905	0688	0481	0283	0094	29
30	2833	2499	2188	1899	1627	1372	1130	0902	0685	0478	0280	0091	30
31	2827	2493	2183	1894	1623	1368	1126	0898	0681	0474	0277	0088	31
32	2821	2488	2178	1889	1618	1363	1123	0895	0677	0471	0274	0085	32
33	2816	2483	2173	1885	1614	1359	1119	0891	0674	0468	0271	0082	33
34	2810	2477	2168	1880	1610	1355	1115	0887	0670	0464	0267	0079	34
35	2804	2472	2163	1875	1605	1351	1111	0883	0667	0461	0264	0076	35
36	2798	2467	2159	1871	1601	1347	1107	0880	0663	0458	0261	0073	36
37	2793	2461	2154	1866	1597	1343	1103	0876	0660	0454	0258	0070	37
38	2787	2456	2149	1862	1592	1339	1099	0872	0656	0451	0255	0067	38
39	2781	2451	2144	1857	1588	1335	1095	0868	0653	0447	0251	0064	39
40	2775	2445	2139	1852	1584	1331	1091	0865	0649	0444	0248	0061	40
41	2770	2440	2134	1848	1579	1326	1088	0861	0646	0441	0245	0058	41
42	2764	2435	2129	1843	1575	1322	1084	0858	0642	0438	0242	0055	42
43	2758	2430	2124	1838	1571	1318	1080	0854	0639	0434	0239	0052	43
44	2753	2424	2119	1834	1566	1314	1076	0850	0635	0431	0235	0048	44
45	2747	2419	2114	1829	1562	1310	1072	0846	0632	0427	0232	0045	45
46	2741	2414	2109	1825	1558	1306	1068	0843	0628	0424	0229	0042	46
47	2736	2409	2104	1820	1553	1302	1064	0839	0625	0421	0226	0039	47
48	2730	2403	2099	1816	1549	1298	1060	0835	0621	0418	0223	0036	48
49	2724	2398	2095	1811	1545	1294	1057	0832	0618	0414	0220	0033	49
50	2719	2393	2090	1806	1540	1290	1053	0828	0614	0411	0216	0030	50
51	2713	2388	2085	1802	1536	1286	1049	0824	0611	0408	0213	0027	51
52	2707	2382	2080	1797	1532	1282	1045	0821	0608	0404	0210	0024	52
53	2702	2377	2075	1793	1527	1278	1041	0817	0604	0401	0207	0021	53
54	2696	2372	2070	1788	1523	1274	1037	0814	0601	0398	0204	0018	54
55	2690	2367	2065	1784	1519	1270	1034	0810	0597	0394	0201	0015	55
56	2685	2362	2061	1779	1515	1265	1030	0806	0594	0391	0197	0012	56
57	2679	2356	2056	1774	1510	1261	1026	0803	0590	0388	0194	0009	57
58	2674	2351	2051	1770	1506	1257	1022	0799	0587	0384	0191	0006	58
59	2668	2346	2046	1765	1502	1253	1018	0795	0583	0381	0188	0003	59
	12	13	14	15	16	17	18	19	20	21	22	23	

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 0′	h. m. 0° 1′	h. m. 0° 2′	h. m. 0° 3′	h. m. 0° 4′	h. m. 0° 5′	h. m. 0° 6′	h. m. 0° 7′	h. m. 0° 8′	s. ″
0		2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	0
1	4.0334	2.2481	1.9506	1.7757	1.6514	1.5549	1.4759	1.4091	1.3513	1
2	3.7324	2.2410	1.9471	1.7734	1.6496	1.5534	1.4747	1.4081	1.3504	2
3	3.5563	2.2341	1.9435	1.7710	1.6478	1.5520	1.4735	1.4071	1.3495	3
4	3.4314	2.2272	1.9400	1.7686	1.6460	1.5506	1.4723	1.4061	1.3486	4
5	3.3345	2.2205	1.9365	1.7663	1.6443	1.5491	1.4711	1.4050	1.3477	5
6	3.2553	2.2139	1.9331	1.7639	1.6425	1.5477	1.4699	1.4040	1.3468	6
7	3.1883	2.2073	1.9296	1.7616	1.6407	1.5463	1.4688	1.4030	1.3459	7
8	3.1303	2.2009	1.9262	1.7593	1.6390	1.5449	1.4676	1.4020	1.3450	8
9	3.0792	2.1946	1.9228	1.7570	1.6372	1.5435	1.4664	1.4010	1.3441	9
10	3.0334	2.1883	1.9195	1.7547	1.6355	1.5421	1.4652	1.4000	1.3432	10
11	2.9920	2.1822	1.9162	1.7524	1.6338	1.5407	1.4640	1.3989	1.3423	11
12	2.9542	2.1761	1.9128	1.7501	1.6320	1.5393	1.4629	1.3979	1.3415	12
13	2.9195	2.1701	1.9096	1.7479	1.6303	1.5379	1.4617	1.3969	1.3406	13
14	2.8873	2.1642	1.9063	1.7456	1.6286	1.5365	1.4606	1.3959	1.3397	14
15	2.8573	2.1584	1.9031	1.7434	1.6269	1.5351	1.4594	1.3949	1.3388	15
16	2.8293	2.1526	1.8999	1.7412	1.6252	1.5337	1.4582	1.3939	1.3379	16
17	2.8030	2.1469	1.8967	1.7390	1.6235	1.5324	1.4571	1.3929	1.3371	17
18	2.7782	2.1413	1.8935	1.7368	1.6218	1.5310	1.4559	1.3919	1.3362	18
19	2.7547	2.1358	1.8904	1.7346	1.6201	1.5296	1.4548	1.3910	1.3353	19
20	2.7324	2.1303	1.8873	1.7324	1.6185	1.5283	1.4536	1.3900	1.3345	20
21	2.7112	2.1249	1.8842	1.7302	1.6168	1.5269	1.4525	1.3890	1.3336	21
22	2.6910	2.1196	1.8811	1.7281	1.6151	1.5256	1.4514	1.3880	1.3327	22
23	2.6717	2.1143	1.8781	1.7259	1.6135	1.5242	1.4502	1.3870	1.3319	23
24	2.6532	2.1091	1.8751	1.7238	1.6118	1.5229	1.4491	1.3860	1.3310	24
25	2.6355	2.1040	1.8721	1.7217	1.6102	1.5215	1.4480	1.3851	1.3301	25
26	2.6185	2.0989	1.8691	1.7196	1.6085	1.5202	1.4468	1.3841	1.3293	26
27	2.6021	2.0939	1.8661	1.7175	1.6069	1.5189	1.4457	1.3831	1.3284	27
28	2.5863	2.0889	1.8632	1.7154	1.6053	1.5175	1.4446	1.3821	1.3276	28
29	2.5710	2.0840	1.8602	1.7133	1.6037	1.5162	1.4435	1.3812	1.3267	29
30	2.5563	2.0792	1.8573	1.7112	1.6021	1.5149	1.4424	1.3802	1.3259	30
31	2.5421	2.0744	1.8544	1.7091	1.6005	1.5136	1.4412	1.3792	1.3250	31
32	2.5283	2.0696	1.8516	1.7071	1.5989	1.5123	1.4401	1.3783	1.3242	32
33	2.5149	2.0649	1.8187	1.7050	1.5973	1.5110	1.4390	1.3773	1.3233	33
34	2.5019	2.0603	1.8459	1.7030	1.5957	1.5097	1.4379	1.3764	1.3225	34
35	2.4894	2.0557	1.8431	1.7010	1.5941	1.5084	1.4368	1.3754	1.3216	35
36	2.4771	2.0512	1.8403	1.6990	1.5925	1.5071	1.4357	1.3745	1.3208	36
37	2.4652	2.0467	1.8375	1.6970	1.5909	1.5058	1.4346	1.3735	1.3199	37
38	2.4536	2.0422	1.8348	1.6950	1.5894	1.5045	1.4335	1.3726	1.3191	38
39	2.4424	2.0378	1.8320	1.6930	1.5878	1.5032	1.4325	1.3716	1.3183	39
40	2.4314	2.0334	1.8293	1.6910	1.5863	1.5019	1.4314	1.3707	1.3174	40
41	2.4206	2.0291	1.8266	1.6890	1.5847	1.5007	1.4303	1.3697	1.3166	41
42	2.4102	2.0248	1.8239	1.6871	1.5832	1.4994	1.4292	1.3688	1.3158	42
43	2.4000	2.0206	1.8212	1.6851	1.5816	1.4981	1.4281	1.3678	1.3149	43
44	2.3900	2.0164	1.8186	1.6832	1.5801	1.4969	1.4270	1.3669	1.3141	44
45	2.3802	2.0122	1.8159	1.6812	1.5786	1.4956	1.4260	1.3660	1.3133	45
46	2.3707	2.0081	1.8133	1.6793	1.5771	1.4943	1.4249	1.3650	1.3124	46
47	2.3613	2.0040	1.8107	1.6774	1.5755	1.4931	1.4238	1.3641	1.3116	47
48	2.3522	2.0000	1.8081	1.6755	1.5740	1.4918	1.4228	1.3632	1.3108	48
49	2.3432	1.9960	1.8055	1.6736	1.5725	1.4906	1.4217	1.3623	1.3100	49
50	2.3345	1.9920	1.8030	1.6717	1.5710	1.4894	1.4206	1.3613	1.3091	50
51	2.3259	1.9881	1.8004	1.6698	1.5695	1.4881	1.4196	1.3604	1.3083	51
52	2.3174	1.9842	1.7979	1.6679	1.5680	1.4869	1.4185	1.3595	1.3075	52
53	2.3091	1.9803	1.7954	1.6661	1.5666	1.4856	1.4175	1.3586	1.3067	53
54	2.3010	1.9765	1.7929	1.6642	1.5651	1.4844	1.4164	1.3576	1.3059	54
55	2.2931	1.9727	1.7904	1.6624	1.5636	1.4832	1.4154	1.3567	1.3051	55
56	2.2852	1.9690	1.7879	1.6605	1.5621	1.4820	1.4143	1.3558	1.3043	56
57	2.2775	1.9652	1.7855	1.6587	1.5607	1.4808	1.4133	1.3549	1.3034	57
58	2.2700	1.9615	1.7830	1.6568	1.5592	1.4795	1.4122	1.3540	1.3026	58
59	2.2626	1.9579	1.7806	1.6550	1.5578	1.4783	1.4112	1.3531	1.3018	59
60	2.2553	1.9542	1.7782	1.6532	1.5563	1.4771	1.4102	1.3522	1.3010	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 9′	h. m. 0° 10′	h. m. 0° 11′	h. m. 0° 12′	h. m. 0° 13′	h. m. 0° 14′	h. m. 0° 15′	h. m. 0° 16′	h. m. 0° 17′	s. ″
0	1.3010	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248	0
1	1.3002	1.2545	1.2132	1.1755	1.1408	1.1086	1.0787	1.0507	1.0244	1
2	1.2994	1.2538	1.2126	1.1749	1.1402	1.1081	1.0782	1.0502	1.0240	2
3	1.2986	1.2531	1.2119	1.1743	1.1397	1.1076	1.0777	1.0498	1.0235	3
4	1.2978	1.2524	1.2113	1.1737	1.1391	1.1071	1.0773	1.0493	1.0231	4
5	1.2970	1.2517	1.2106	1.1731	1.1386	1.1066	1.0768	1.0489	1.0227	5
6	1.2962	1.2510	1.2099	1.1725	1.1380	1.1061	1.0763	1.0484	1.0223	6
7	1.2954	1.2502	1.2093	1.1719	1.1374	1.1055	1.0758	1.0480	1.0219	7
8	1.2946	1.2495	1.2086	1.1713	1.1369	1.1050	1.0753	1.0475	1.0214	8
9	1.2939	1.2488	1.2080	1.1707	1.1363	1.1045	1.0749	1.0471	1.0210	9
10	1.2931	1.2481	1.2073	1.1701	1.1358	1.1040	1.0744	1.0467	1.0206	10
11	1.2923	1.2474	1.2067	1.1695	1.1352	1.1035	1.0739	1.0462	1.0202	11
12	1.2915	1.2467	1.2061	1.1689	1.1347	1.1030	1.0734	1.0458	1.0197	12
13	1.2907	1.2460	1.2054	1.1683	1.1342	1.1025	1.0730	1.0453	1.0193	13
14	1.2899	1.2453	1.2048	1.1677	1.1336	1.1020	1.0725	1.0449	1.0189	14
15	1.2891	1.2445	1.2041	1.1671	1.1331	1.1015	1.0720	1.0444	1.0185	15
16	1.2883	1.2438	1.2035	1.1665	1.1325	1.1009	1.0715	1.0440	1.0181	16
17	1.2876	1.2431	1.2028	1.1660	1.1320	1.1004	1.0711	1.0435	1.0176	17
18	1.2868	1.2424	1.2022	1.1654	1.1314	1.0999	1.0706	1.0431	1.0172	18
19	1.2860	1.2417	1.2016	1.1648	1.1309	1.0994	1.0701	1.0426	1.0168	19
20	1.2852	1.2410	1.2009	1.1642	1.1303	1.0989	1.0696	1.0422	1.0164	20
21	1.2845	1.2403	1.2003	1.1636	1.1298	1.0984	1.0692	1.0418	1.0160	21
22	1.2837	1.2396	1.1996	1.1630	1.1292	1.0979	1.0687	1.0413	1.0156	22
23	1.2829	1.2389	1.1990	1.1624	1.1287	1.0974	1.0682	1.0409	1.0151	23
24	1.2821	1.2382	1.1984	1.1619	1.1282	1.0969	1.0678	1.0404	1.0147	24
25	1.2814	1.2375	1.1977	1.1613	1.1276	1.0964	1.0673	1.0400	1.0143	25
26	1.2806	1.2368	1.1971	1.1607	1.1271	1.0959	1.0668	1.0395	1.0139	26
27	1.2798	1.2362	1.1965	1.1601	1.1266	1.0954	1.0663	1.0391	1.0135	27
28	1.2791	1.2355	1.1958	1.1595	1.1260	1.0949	1.0659	1.0387	1.0131	28
29	1.2783	1.2348	1.1952	1.1589	1.1255	1.0944	1.0654	1.0382	1.0126	29
30	1.2775	1.2341	1.1946	1.1584	1.1249	1.0939	1.0649	1.0378	1.0122	30
31	1.2768	1.2334	1.1939	1.1578	1.1244	1.0934	1.0645	1.0374	1.0118	31
32	1.2760	1.2327	1.1933	1.1572	1.1239	1.0929	1.0640	1.0369	1.0114	32
33	1.2753	1.2320	1.1927	1.1566	1.1233	1.0924	1.0635	1.0365	1.0110	33
34	1.2745	1.2313	1.1921	1.1561	1.1228	1.0919	1.0631	1.0360	1.0106	34
35	1.2738	1.2307	1.1914	1.1555	1.1223	1.0914	1.0626	1.0356	1.0102	35
36	1.2730	1.2300	1.1908	1.1549	1.1217	1.0909	1.0621	1.0352	1.0098	36
37	1.2722	1.2293	1.1902	1.1543	1.1212	1.0904	1.0617	1.0347	1.0093	37
38	1.2715	1.2286	1.1896	1.1538	1.1207	1.0899	1.0612	1.0343	1.0089	38
39	1.2707	1.2279	1.1889	1.1532	1.1201	1.0894	1.0608	1.0339	1.0085	39
40	1.2700	1.2272	1.1883	1.1526	1.1196	1.0889	1.0603	1.0334	1.0081	40
41	1.2692	1.2266	1.1877	1.1520	1.1191	1.0884	1.0598	1.0330	1.0077	41
42	1.2685	1.2259	1.1871	1.1515	1.1186	1.0880	1.0594	1.0326	1.0073	42
43	1.2678	1.2252	1.1865	1.1509	1.1180	1.0875	1.0589	1.0321	1.0069	43
44	1.2670	1.2245	1.1858	1.1503	1.1175	1.0870	1.0585	1.0317	1.0065	44
45	1.2663	1.2239	1.1852	1.1498	1.1170	1.0865	1.0580	1.0313	1.0061	45
46	1.2655	1.2232	1.1846	1.1492	1.1164	1.0860	1.0575	1.0308	1.0057	46
47	1.2648	1.2225	1.1840	1.1486	1.1159	1.0855	1.0571	1.0304	1.0053	47
48	1.2640	1.2218	1.1834	1.1481	1.1154	1.0850	1.0566	1.0300	1.0049	48
49	1.2633	1.2212	1.1828	1.1475	1.1149	1.0845	1.0562	1.0295	1.0044	49
50	1.2626	1.2205	1.1822	1.1469	1.1143	1.0840	1.0557	1.0291	1.0040	50
51	1.2618	1.2198	1.1816	1.1464	1.1138	1.0835	1.0552	1.0287	1.0036	51
52	1.2611	1.2192	1.1809	1.1458	1.1133	1.0831	1.0548	1.0282	1.0032	52
53	1.2604	1.2185	1.1803	1.1452	1.1128	1.0826	1.0543	1.0278	1.0028	53
54	1.2596	1.2178	1.1797	1.1447	1.1123	1.0821	1.0539	1.0274	1.0024	54
55	1.2589	1.2172	1.1791	1.1441	1.1117	1.0816	1.0534	1.0270	1.0020	55
56	1.2582	1.2165	1.1785	1.1436	1.1112	1.0811	1.0530	1.0265	1.0016	56
57	1.2574	1.2159	1.1779	1.1430	1.1107	1.0806	1.0525	1.0261	1.0012	57
58	1.2567	1.2152	1.1773	1.1424	1.1102	1.0801	1.0521	1.0257	1.0008	58
59	1.2560	1.2145	1.1767	1.1419	1.1097	1.0797	1.0516	1.0252	1.0004	59
60	1.2553	1.2139	1.1761	1.1413	1.1091	1.0792	1.0512	1.0248	1.0000	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 18′	h. m. 0° 19′	h. m. 0° 20′	h. m. 0° 21′	h. m. 0° 22′	h. m. 0° 23′	h. m. 0° 24′	h. m. 0° 25′	h. m. 0° 26′	h. m. 0° 27′	h. m. 0° 28′	h. m. 0° 29′	s. ″
0	10000	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	0
1	9996	9761	9539	9327	9125	8932	8748	8570	8400	8236	8079	7926	1
2	9992	9758	9535	9324	9122	8929	8745	8568	8397	8234	8076	7924	2
3	9988	9754	9532	9320	9119	8926	8742	8565	8395	8231	8073	7921	3
4	9984	9750	9528	9317	9115	8923	8739	8562	8392	8228	8071	7919	4
5	9980	9746	9524	9313	9112	8920	8736	8559	8389	8226	8068	7916	5
6	9976	9742	9521	9310	9109	8917	8733	8556	8386	8223	8066	7914	6
7	9972	9739	9517	9306	9106	8913	8730	8553	8384	8220	8063	7911	7
8	9968	9735	9514	9303	9102	8910	8727	8550	8381	8218	8061	7909	8
9	9964	9731	9510	9300	9099	8907	8724	8547	8378	8215	8058	7906	9
10	9960	9727	9506	9296	9096	8904	8721	8544	8375	8212	8055	7904	10
11	9956	9723	9503	9293	9092	8901	8718	8542	8372	8210	8053	7901	11
12	9952	9720	9499	9289	9089	8898	8715	8539	8370	8207	8050	7899	12
13	9948	9716	9496	9286	9086	8895	8712	8536	8367	8204	8048	7896	13
14	9944	9712	9492	9283	9083	8892	8709	8533	8364	8202	8045	7894	14
15	9940	9708	9488	9279	9079	8888	8706	8530	8361	8199	8043	7891	15
16	9936	9705	9485	9276	9076	8885	8703	8527	8359	8196	8040	7889	16
17	9932	9701	9481	9272	9073	8882	8700	8524	8356	8194	8037	7887	17
18	9928	9697	9478	9269	9070	8879	8697	8522	8353	8191	8035	7884	18
19	9924	9693	9474	9266	9066	8876	8694	8519	8350	8188	8032	7882	19
20	9920	9690	9471	9262	9063	8873	8691	8516	8348	8186	8030	7879	20
21	9916	9686	9467	9259	9060	8870	8688	8513	8345	8183	8027	7877	21
22	9912	9682	9464	9255	9057	8867	8685	8510	8342	8181	8025	7874	22
23	9908	9678	9460	9252	9053	8864	8682	8507	8339	8178	8022	7872	23
24	9905	9675	9456	9249	9050	8861	8679	8504	8337	8175	8020	7869	24
25	9901	9671	9453	9245	9047	8857	8676	8502	8334	8173	8017	7867	25
26	9897	9667	9449	9242	9044	8854	8673	8499	8331	8170	8014	7864	26
27	9893	9664	9446	9238	9041	8851	8670	8496	8328	8167	8012	7862	27
28	9889	9660	9442	9235	9037	8848	8667	8493	8326	8165	8009	7859	28
29	9885	9656	9439	9232	9034	8845	8664	8490	8323	8162	8007	7857	29
30	9881	9652	9435	9228	9031	8842	8661	8487	8320	8159	8004	7855	30
31	9877	9649	9432	9225	9028	8839	8658	8484	8318	8157	8002	7852	31
32	9873	9645	9428	9222	9024	8836	8655	8482	8315	8154	7999	7850	32
33	9869	9641	9425	9218	9021	8833	8652	8479	8312	8152	7997	7847	33
34	9865	9638	9421	9215	9018	8830	8649	8476	8309	8149	7994	7845	34
35	9861	9634	9418	9212	9015	8827	8646	8473	8307	8146	7992	7842	35
36	9858	9630	9414	9208	9012	8824	8643	8470	8304	8144	7989	7840	36
37	9854	9626	9411	9205	9008	8821	8640	8467	8301	8141	7987	7837	37
38	9850	9623	9407	9201	9005	8817	8637	8465	8298	8138	7984	7835	38
39	9846	9619	9404	9198	9002	8814	8635	8462	8296	8136	7981	7832	39
40	9842	9615	9400	9195	8999	8811	8632	8459	8293	8133	7979	7830	40
41	9838	9612	9397	9191	8996	8808	8629	8456	8290	8131	7976	7828	41
42	9834	9608	9393	9188	8992	8805	8626	8453	8288	8128	7974	7825	42
43	9830	9604	9390	9185	8989	8802	8623	8451	8285	8125	7971	7823	43
44	9827	9601	9386	9181	8986	8799	8620	8448	8282	8123	7969	7820	44
45	9823	9597	9383	9178	8983	8796	8617	8445	8279	8120	7966	7818	45
46	9819	9593	9379	9175	8980	8793	8614	8442	8277	8117	7964	7815	46
47	9815	9590	9376	9172	8977	8790	8612	8439	8274	8115	7961	7813	47
48	9811	9586	9372	9168	8973	8787	8608	8437	8271	8112	7959	7811	48
49	9807	9582	9369	9165	8970	8784	8605	8434	8269	8110	7956	7808	49
50	9803	9579	9365	9162	8967	8781	8602	8431	8266	8107	7954	7806	50
51	9800	9575	9362	9158	8964	8778	8599	8428	8263	8104	7951	7803	51
52	9796	9571	9358	9155	8961	8775	8597	8425	8261	8102	7949	7801	52
53	9792	9568	9355	9152	8958	8772	8594	8423	8258	8099	7946	7798	53
54	9788	9564	9351	9148	8954	8769	8591	8420	8255	8097	7944	7796	54
55	9784	9561	9348	9145	8951	8766	8588	8417	8253	8094	7941	7794	55
56	9780	9557	9344	9142	8948	8763	8585	8414	8250	8091	7939	7791	56
57	9777	9553	9341	9138	8945	8760	8582	8411	8247	8089	7936	7789	57
58	9773	9550	9337	9135	8942	8757	8579	8409	8244	8086	7934	7786	58
59	9769	9546	9334	9132	8939	8754	8576	8406	8242	8084	7931	7784	59
60	9765	9542	9331	9128	8935	8751	8573	8403	8239	8081	7929	7782	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 30′	h. m. 0° 31′	h. m. 0° 32′	h. m. 0° 33′	h. m. 0° 34′	h. m. 0° 35′	h. m. 0° 36′	h. m. 0° 37′	h. m. 0° 38′	h. m. 0° 39′	h. m. 0° 40′	h. m. 0° 41′	s. ″
0	7782	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	0
1	7779	7637	7499	7365	7236	7110	6988	6869	6753	6640	6530	6423	1
2	7777	7634	7497	7363	7234	7108	6986	6867	6751	6638	6529	6421	2
3	7774	7632	7494	7361	7232	7106	6984	6865	6749	6637	6527	6420	3
4	7772	7630	7492	7359	7229	7104	6982	6863	6747	6635	6525	6418	4
5	7769	7627	7490	7357	7227	7102	6980	6861	6745	6633	6523	6416	5
6	7767	7625	7488	7354	7225	7100	6978	6859	6743	6631	6521	6414	6
7	7765	7623	7485	7352	7223	7098	6976	6857	6742	6629	6519	6413	7
8	7762	7620	7483	7350	7221	7096	6974	6855	6740	6627	6518	6411	8
9	7760	7618	7481	7348	7219	7093	6972	6853	6738	6625	6516	6409	9
10	7757	7616	7479	7346	7217	7091	6970	6851	6736	6624	6514	6407	10
11	7755	7613	7476	7344	7215	7089	6968	6849	6734	6622	6512	6406	11
12	7753	7611	7474	7341	7212	7087	6966	6847	6732	6620	6510	6404	12
13	7750	7609	7472	7339	7210	7085	6964	6845	6730	6618	6509	6402	13
14	7748	7607	7470	7337	7208	7083	6962	6843	6728	6616	6507	6400	14
15	7745	7604	7467	7335	7206	7081	6960	6841	6726	6614	6505	6398	15
16	7743	7602	7465	7333	7204	7079	6958	6840	6725	6612	6503	6397	16
17	7741	7600	7463	7330	7202	7077	6956	6838	6723	6611	6501	6395	17
18	7738	7597	7461	7328	7200	7075	6954	6836	6721	6609	6500	6393	18
19	7736	7595	7458	7326	7198	7073	6952	6834	6719	6607	6498	6391	19
20	7734	7593	7456	7324	7196	7071	6950	6832	6717	6605	6496	6390	20
21	7731	7590	7454	7322	7193	7069	6948	6830	6715	6603	6494	6388	21
22	7729	7588	7452	7320	7191	7067	6946	6828	6713	6601	6492	6386	22
23	7726	7586	7450	7317	7189	7065	6944	6826	6711	6600	6491	6384	23
24	7724	7583	7447	7315	7187	7063	6942	6824	6709	6598	6489	6383	24
25	7722	7581	7445	7313	7185	7061	6940	6822	6708	6596	6487	6381	25
26	7719	7579	7443	7311	7183	7059	6938	6820	6706	6594	6485	6379	26
27	7717	7577	7441	7309	7181	7057	6936	6818	6704	6592	6484	6377	27
28	7714	7574	7438	7307	7179	7055	6934	6816	6702	6590	6482	6376	28
29	7712	7572	7436	7304	7177	7052	6932	6814	6700	6589	6480	6374	29
30	7710	7570	7434	7302	7175	7050	6930	6812	6698	6587	6478	6372	30
31	7707	7567	7432	7300	7172	7048	6928	6810	6696	6585	6476	6371	31
32	7705	7565	7429	7298	7170	7046	6926	6809	6694	6583	6475	6369	32
33	7703	7563	7427	7296	7168	7044	6924	6807	6692	6581	6473	6367	33
34	7700	7560	7425	7294	7166	7042	6922	6805	6691	6579	6471	6365	34
35	7698	7558	7423	7291	7164	7040	6920	6803	6689	6578	6469	6364	35
36	7696	7556	7421	7289	7162	7038	6918	6801	6687	6576	6467	6362	36
37	7693	7554	7418	7287	7160	7036	6916	6799	6685	6574	6466	6360	37
38	7691	7551	7416	7285	7158	7034	6914	6797	6683	6572	6464	6358	38
39	7688	7549	7414	7283	7156	7032	6912	6795	6681	6570	6462	6357	39
40	7686	7547	7412	7281	7154	7030	6910	6793	6679	6568	6460	6355	40
41	7684	7544	7409	7279	7152	7028	6908	6791	6677	6567	6459	6353	41
42	7681	7542	7407	7276	7149	7026	6906	6789	6676	6565	6457	6351	42
43	7679	7540	7405	7274	7147	7024	6904	6787	6674	6563	6455	6350	43
44	7677	7538	7403	7272	7145	7022	6902	6785	6672	6561	6453	6348	44
45	7674	7535	7401	7270	7143	7020	6900	6784	6670	6559	6451	6346	45
46	7672	7533	7398	7268	7141	7018	6898	6782	6668	6558	6450	6344	46
47	7670	7531	7396	7266	7139	7016	6896	6780	6666	6556	6448	6343	47
48	7667	7528	7394	7264	7137	7014	6894	6778	6664	6554	6446	6341	48
49	7665	7526	7392	7261	7135	7012	6892	6776	6663	6552	6444	6339	49
50	7663	7524	7390	7259	7133	7010	6890	6774	6661	6550	6443	6338	50
51	7660	7522	7387	7257	7131	7008	6888	6772	6659	6548	6441	6336	51
52	7658	7519	7385	7255	7129	7006	6886	6770	6657	6547	6439	6334	52
53	7655	7517	7383	7253	7127	7004	6884	6768	6655	6545	6437	6332	53
54	7653	7515	7381	7251	7124	7002	6882	6766	6653	6543	6435	6331	54
55	7651	7513	7379	7249	7122	7000	6881	6764	6651	6541	6434	6329	55
56	7648	7510	7376	7246	7120	6998	6879	6763	6650	6539	6432	6327	56
57	7646	7508	7374	7244	7118	6996	6877	6761	6648	6538	6430	6325	57
58	7644	7506	7372	7242	7116	6994	6875	6759	6646	6536	6428	6324	58
59	7641	7503	7370	7240	7114	6992	6873	6757	6644	6534	6427	6322	59
60	7639	7501	7368	7238	7112	6990	6871	6755	6642	6532	6425	6320	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 42′	h. m. 0° 43′	h. m. 0° 44′	h. m. 0° 45′	h. m. 0° 46′	h. m. 0° 47′	h. m. 0° 48′	h. m. 0° 49′	h. m. 0° 50′	h. m. 0° 51′	h. m. 0° 52′	h. m. 0° 53′	s. ″
0	6320	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	0
1	6319	6216	6117	6019	5924	5830	5739	5649	5562	5476	5391	5309	1
2	6317	6215	6115	6017	5922	5829	5737	5648	5560	5474	5390	5307	2
3	6315	6213	6113	6016	5920	5827	5736	5646	5559	5473	5389	5306	3
4	6313	6211	6112	6014	5919	5826	5734	5645	5557	5471	5387	5305	4
5	6312	6210	6110	6013	5917	5824	5733	5643	5556	5470	5386	5303	5
6	6310	6208	6108	6011	5916	5823	5731	5642	5554	5469	5384	5302	6
7	6308	6206	6107	6009	5914	5821	5730	5640	5553	5467	5383	5300	7
8	6306	6205	6105	6008	5913	5819	5728	5639	5551	5466	5382	5299	8
9	6305	6203	6103	6006	5911	5818	5727	5637	5550	5464	5380	5298	9
10	6303	6201	6102	6005	5909	5816	5725	5636	5549	5463	5379	5296	10
11	6301	6200	6100	6003	5908	5815	5724	5635	5547	5461	5377	5295	11
12	6300	6198	6099	6001	5906	5813	5722	5633	5546	5460	5376	5294	12
13	6298	6196	6097	6000	5905	5812	5721	5632	5544	5459	5375	5292	13
14	6296	6195	6095	5998	5903	5810	5719	5630	5543	5457	5373	5291	14
15	6294	6193	6094	5997	5902	5809	5718	5629	5541	5456	5372	5290	15
16	6293	6191	6092	5995	5900	5807	5716	5627	5540	5454	5370	5288	16
17	6291	6190	6090	5993	5898	5806	5715	5626	5538	5453	5369	5287	17
18	6289	6188	6089	5992	5897	5804	5713	5624	5537	5452	5368	5285	18
19	6288	6186	6087	5990	5895	5803	5712	5623	5536	5450	5366	5284	19
20	6286	6185	6085	5989	5894	5801	5710	5621	5534	5449	5365	5283	20
21	6284	6183	6084	5987	5892	5800	5709	5620	5533	5447	5364	5281	21
22	6282	6181	6082	5985	5891	5798	5707	5618	5531	5446	5362	5280	22
23	6281	6179	6081	5984	5889	5796	5706	5617	5530	5445	5361	5279	23
24	6279	6178	6079	5982	5888	5795	5704	5615	5528	5443	5359	5277	24
25	6277	6176	6077	5981	5886	5793	5703	5614	5527	5442	5358	5276	25
26	6276	6174	6076	5979	5884	5792	5701	5613	5526	5440	5357	5275	26
27	6274	6173	6074	5977	5883	5790	5700	5611	5524	5439	5355	5273	27
28	6272	6171	6072	5976	5881	5789	5698	5610	5522	5437	5354	5272	28
29	6271	6169	6071	5974	5880	5787	5697	5608	5521	5436	5353	5271	29
30	6269	6168	6069	5973	5878	5786	5695	5607	5520	5435	5351	5269	30
31	6267	6166	6067	5971	5877	5784	5694	5605	5518	5433	5350	5268	31
32	6265	6165	6066	5969	5875	5783	5692	5604	5517	5432	5348	5266	32
33	6264	6163	6064	5968	5874	5781	5691	5602	5516	5430	5347	5265	33
34	6262	6161	6063	5966	5872	5780	5689	5601	5514	5429	5346	5264	34
35	6260	6160	6061	5965	5870	5778	5688	5599	5513	5428	5344	5262	35
36	6259	6158	6059	5963	5869	5777	5686	5598	5511	5426	5343	5261	36
37	6257	6156	6058	5961	5867	5775	5685	5596	5510	5425	5341	5260	37
38	6255	6155	6056	5960	5866	5774	5683	5595	5508	5423	5340	5258	38
39	6254	6153	6055	5958	5864	5772	5682	5594	5507	5422	5339	5257	39
40	6252	6151	6053	5957	5863	5771	5680	5592	5506	5421	5337	5256	40
41	6250	6150	6051	5955	5861	5769	5679	5591	5504	5419	5336	5254	41
42	6248	6148	6050	5954	5860	5768	5677	5589	5503	5418	5335	5253	42
43	6247	6146	6048	5952	5858	5766	5676	5588	5501	5416	5333	5252	43
44	6245	6145	6046	5950	5856	5765	5674	5586	5500	5415	5332	5250	44
45	6243	6143	6045	5949	5855	5763	5673	5585	5498	5414	5331	5249	45
46	6242	6141	6043	5947	5853	5761	5671	5583	5497	5412	5329	5248	46
47	6240	6140	6042	5946	5852	5760	5670	5582	5496	5411	5328	5246	47
48	6238	6138	6040	5944	5850	5758	5669	5580	5494	5409	5326	5245	48
49	6237	6136	6038	5942	5849	5757	5667	5579	5493	5408	5325	5244	49
50	6235	6135	6037	5941	5847	5755	5666	5578	5491	5407	5324	5242	50
51	6233	6133	6035	5939	5846	5754	5664	5576	5490	5405	5322	5241	51
52	6232	6131	6033	5938	5844	5752	5663	5575	5488	5404	5321	5240	52
53	6230	6130	6032	5936	5843	5751	5661	5573	5487	5402	5320	5238	53
54	6228	6128	6030	5935	5841	5749	5660	5572	5486	5401	5318	5237	54
55	6226	6126	6029	5933	5839	5748	5658	5570	5484	5400	5317	5235	55
56	6225	6125	6027	5931	5838	5746	5657	5569	5483	5398	5315	5234	56
57	6223	6123	6025	5930	5836	5745	5655	5567	5481	5397	5314	5233	57
58	6221	6121	6024	5928	5835	5743	5654	5566	5480	5395	5313	5231	58
59	6220	6120	6022	5927	5833	5742	5652	5564	5478	5394	5311	5230	59
60	6218	6118	6021	5925	5832	5740	5651	5563	5477	5393	5310	5229	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 0° 54′	h. m. 0° 55′	h. m. 0° 56′	h. m. 0° 57′	h. m. 0° 58′	h. m. 0° 59′	h. m. 1° 0′	h. m. 1° 1′	h. m. 1° 2′	h. m. 1° 3′	h. m. 1° 4′	h. m. 1° 5′	s. ″
0	5229	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424	0
1	5227	5148	5070	4993	4917	4843	4770	4698	4628	4558	4490	4422	1
2	5226	5146	5068	4991	4916	4842	4769	4697	4626	4557	4489	4421	2
3	5225	5145	5067	4990	4915	4841	4768	4696	4625	4556	4488	4420	3
4	5223	5144	5066	4989	4913	4839	4766	4695	4624	4555	4486	4419	4
5	5222	5143	5064	4988	4912	4838	4765	4693	4623	4554	4485	4418	5
6	5221	5141	5063	4986	4911	4837	4764	4692	4622	4552	4484	4417	6
7	5219	5140	5062	4985	4910	4836	4763	4691	4621	4551	4483	4416	7
8	5218	5139	5061	4984	4908	4834	4762	4690	4619	4550	4482	4415	8
9	5217	5137	5059	4983	4907	4833	4760	4689	4618	4549	4481	4414	9
10	5215	5136	5058	4981	4906	4832	4759	4688	4617	4548	4480	4412	10
11	5214	5135	5057	4980	4905	4831	4758	4686	4616	4547	4479	4411	11
12	5213	5133	5055	4979	4903	4830	4757	4685	4615	4546	4477	4410	12
13	5211	5132	5054	4977	4902	4828	4756	4684	4614	4544	4476	4409	13
14	5210	5131	5053	4976	4901	4827	4754	4683	4612	4543	4475	4408	14
15	5209	5129	5051	4975	4900	4826	4753	4682	4611	4542	4474	4407	15
16	5207	5128	5050	4974	4899	4825	4752	4680	4610	4541	4473	4406	16
17	5206	5127	5049	4972	4897	4823	4751	4679	4609	4540	4472	4405	17
18	5205	5125	5048	4971	4896	4822	4750	4678	4608	4539	4471	4404	18
19	5203	5124	5046	4970	4895	4821	4748	4677	4607	4538	4469	4402	19
20	5202	5123	5045	4969	4894	4820	4747	4676	4606	4536	4468	4401	20
21	5201	5122	5044	4967	4892	4819	4746	4675	4604	4535	4467	4400	21
22	5199	5120	5043	4966	4891	4817	4745	4673	4603	4534	4466	4399	22
23	5198	5119	5041	4965	4890	4816	4744	4672	4602	4533	4465	4398	23
24	5197	5118	5040	4964	4889	4815	4742	4671	4601	4532	4464	4397	24
25	5195	5116	5039	4962	4887	4814	4741	4670	4600	4531	4463	4396	25
26	5194	5115	5037	4961	4886	4812	4740	4669	4599	4530	4462	4395	26
27	5193	5114	5036	4960	4885	4811	4739	4668	4597	4528	4460	4394	27
28	5191	5112	5035	4959	4884	4810	4738	4666	4596	4527	4459	4393	28
29	5190	5111	5034	4957	4882	4809	4736	4665	4595	4526	4458	4391	29
30	5189	5110	5032	4956	4881	4808	4735	4664	4594	4525	4457	4390	30
31	5187	5108	5031	4955	4880	4806	4734	4663	4593	4524	4456	4389	31
32	5186	5107	5030	4954	4879	4805	4733	4662	4592	4523	4455	4388	32
33	5185	5106	5028	4952	4877	4804	4732	4660	4590	4522	4454	4387	33
34	5183	5105	5027	4951	4876	4803	4730	4659	4589	4520	4453	4386	34
35	5182	5103	5026	4950	4875	4801	4729	4658	4588	4519	4452	4385	35
36	5181	5102	5025	4949	4874	4800	4728	4657	4587	4518	4450	4384	36
37	5179	5101	5023	4947	4873	4799	4727	4656	4586	4517	4449	4383	37
38	5178	5099	5022	4946	4871	4798	4726	4655	4585	4516	4448	4381	38
39	5177	5098	5021	4945	4870	4797	4724	4653	4584	4515	4447	4380	39
40	5175	5097	5019	4943	4869	4795	4723	4652	4582	4514	4446	4379	40
41	5174	5095	5018	4942	4868	4794	4722	4651	4581	4512	4445	4378	41
42	5173	5094	5017	4941	4866	4793	4721	4650	4580	4511	4444	4377	42
43	5172	5093	5016	4940	4865	4792	4720	4649	4579	4510	4443	4376	43
44	5170	5092	5014	4938	4864	4791	4718	4648	4578	4509	4441	4375	44
45	5169	5090	5013	4937	4863	4789	4717	4646	4577	4508	4440	4374	45
46	5168	5089	5012	4936	4861	4788	4716	4645	4575	4507	4439	4373	46
47	5166	5088	5011	4935	4860	4787	4715	4644	4574	4506	4438	4372	47
48	5165	5086	5009	4933	4859	4786	4714	4643	4573	4505	4437	4370	48
49	5164	5085	5008	4932	4858	4785	4712	4642	4572	4503	4436	4369	49
50	5162	5084	5007	4931	4856	4783	4711	4640	4571	4502	4435	4368	50
51	5161	5082	5005	4930	4855	4782	4710	4639	4570	4501	4434	4367	51
52	5160	5081	5004	4928	4854	4781	4709	4638	4569	4500	4433	4366	52
53	5158	5080	5003	4927	4853	4780	4708	4637	4567	4499	4431	4365	53
54	5157	5079	5002	4926	4852	4778	4707	4636	4566	4498	4430	4364	54
55	5156	5077	5000	4925	4850	4777	4705	4635	4565	4497	4429	4363	55
56	5154	5076	4999	4923	4849	4776	4704	4633	4564	4495	4428	4362	56
57	5153	5075	4998	4922	4848	4775	4703	4632	4563	4494	4427	4361	57
58	5152	5073	4997	4921	4847	4774	4702	4631	4562	4493	4426	4359	58
59	5150	5072	4995	4920	4845	4772	4701	4630	4560	4492	4425	4358	59
60	5149	5071	4994	4918	4844	4771	4699	4629	4559	4491	4424	4357	60

TABLE XXXIV

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 6′	h. m. 1° 7′	h. m. 1° 8′	h. m. 1° 9′	h. m. 1° 10′	h. m. 1° 11′	h. m. 1° 12′	h. m. 1° 13′	h. m. 1° 14′	h. m. 1° 15′	h. m. 1° 16′	h. m. 1° 17′	s. ″
0	4357	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	0
1	4356	4291	4227	4163	4101	4039	3978	3919	3859	3801	3744	3687	1
2	4355	4290	4226	4162	4100	4038	3977	3918	3858	3800	3743	3686	2
3	4354	4289	4224	4161	4099	4037	3976	3917	3857	3799	3742	3685	3
4	4353	4288	4223	4160	4098	4036	3975	3916	3856	3798	3741	3684	4
5	4352	4287	4222	4159	4097	4035	3974	3915	3856	3797	3740	3683	5
6	4351	4285	4221	4158	4096	4034	3973	3914	3855	3796	3739	3682	6
7	4350	4284	4220	4157	4095	4033	3972	3913	3854	3795	3738	3681	7
8	4349	4283	4219	4156	4093	4032	3971	3912	3853	3794	3737	3680	8
9	4347	4282	4218	4155	4092	4031	3970	3911	3852	3793	3736	3679	9
10	4346	4281	4217	4154	4091	4030	3969	3910	3851	3792	3735	3678	10
11	4345	4280	4216	4153	4090	4029	3968	3909	3850	3792	3734	3677	11
12	4344	4279	4215	4152	4089	4028	3967	3908	3849	3791	3733	3677	12
13	4343	4278	4214	4151	4088	4027	3966	3907	3848	3790	3732	3676	13
14	4342	4277	4213	4150	4087	4026	3965	3906	3847	3789	3731	3675	14
15	4341	4276	4212	4149	4086	4025	3964	3905	3846	3788	3730	3674	15
16	4349	4275	4211	4147	4085	4024	3963	3904	3845	3787	3729	3673	16
17	4339	4274	4210	4146	4084	4023	3962	3903	3844	3786	3728	3672	17
18	4338	4273	4209	4145	4083	4022	3961	3902	3843	3785	3727	3671	18
19	4336	4271	4207	4144	4082	4021	3960	3901	3842	3784	3727	3670	19
20	4335	4270	4206	4143	4081	4020	3959	3900	3841	3783	3726	3669	20
21	4334	4269	4205	4142	4080	4019	3958	3899	3840	3782	3725	3668	21
22	4333	4268	4204	4141	4079	4018	3957	3898	3839	3781	3724	3667	22
23	4332	4267	4203	4140	4078	4017	3956	3897	3838	3780	3723	3666	23
24	4331	4266	4202	4139	4077	4016	3955	3896	3837	3779	3722	3665	24
25	4330	4265	4201	4138	4076	4015	3954	3895	3836	3778	3721	3664	25
26	4329	4264	4200	4137	4075	4014	3953	3894	3835	3777	3720	3663	26
27	4328	4263	4199	4136	4074	4013	3952	3893	3834	3776	3719	3663	27
28	4327	4262	4198	4135	4073	4012	3951	3892	3833	3775	3718	3662	28
29	4326	4261	4197	4134	4072	4011	3950	3891	3832	3774	3717	3661	29
30	4325	4260	4196	4133	4071	4010	3949	3890	3831	3773	3716	3660	30
31	4323	4259	4195	4132	4070	4009	3948	3889	3830	3772	3715	3659	31
32	4322	4258	4194	4131	4069	4008	3947	3888	3829	3771	3714	3658	32
33	4321	4256	4193	4130	4068	4007	3946	3887	3828	3770	3713	3657	33
34	4320	4255	4192	4129	4067	4006	3945	3886	3827	3769	3712	3656	34
35	4319	4254	4191	4128	4066	4005	3944	3885	3826	3768	3711	3655	35
36	4318	4253	4189	4127	4065	4004	3943	3884	3825	3768	3710	3654	36
37	4317	4252	4188	4126	4064	4003	3942	3883	3824	3767	3709	3653	37
38	4316	4251	4187	4125	4063	4002	3941	3882	3823	3766	3709	3652	38
39	4315	4250	4186	4124	4062	4001	3940	3881	3822	3765	3708	3651	39
40	4314	4249	4185	4122	4061	4000	3939	3880	3821	3764	3707	3650	40
41	4313	4248	4184	4121	4060	3999	3938	3879	3820	3763	3706	3649	41
42	4311	4247	4183	4120	4059	3998	3937	3878	3820	3762	3705	3649	42
43	4310	4246	4182	4119	4058	3997	3936	3877	3819	3761	3704	3648	43
44	4309	4245	4181	4118	4056	3996	3935	3876	3818	3760	3703	3647	44
45	4308	4244	4180	4117	4055	3995	3934	3875	3817	3759	3702	3646	45
46	4307	4243	4179	4116	4054	3993	3933	3874	3816	3758	3701	3645	46
47	4306	4241	4178	4115	4053	3992	3932	3873	3815	3757	3700	3644	47
48	4305	4240	4177	4114	4052	3991	3931	3872	3814	3756	3699	3643	48
49	4304	4239	4176	4113	4051	3990	3930	3871	3813	3755	3698	3642	49
50	4303	4238	4175	4112	4050	3989	3929	3870	3812	3754	3697	3641	50
51	4302	4237	4174	4111	4049	3988	3928	3869	3811	3753	3696	3640	51
52	4301	4236	4173	4110	4048	3987	3927	3868	3810	3752	3695	3639	52
53	4300	4235	4172	4109	4047	3986	3926	3867	3809	3751	3694	3638	53
54	4298	4234	4171	4108	4046	3985	3925	3866	3808	3750	3693	3637	54
55	4297	4233	4169	4107	4045	3984	3924	3865	3807	3749	3693	3636	55
56	4296	4232	4168	4106	4044	3983	3923	3864	3806	3748	3692	3635	56
57	4295	4231	4167	4105	4043	3982	3922	3863	3805	3747	3691	3635	57
58	4294	4230	4166	4104	4042	3981	3921	3862	3804	3746	3690	3634	58
59	4293	4229	4165	4103	4041	3980	3920	3861	3803	3746	3689	3633	59
60	4292	4228	4164	4102	4040	3979	3919	3860	3802	3745	3688	3632	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 18′	h. m. 1° 19′	h. m. 1° 20′	h. m. 1° 21′	h. m. 1° 22′	h. m. 1° 23′	h. m. 1° 24′	h. m. 1° 25′	h. m. 1° 26′	h. m. 1° 27′	h. m. 1° 28′	h. m. 1° 29′	s. ″
0	3632	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	0
1	3631	3576	3521	3467	3414	3361	3309	3258	3207	3157	3107	3058	1
2	3630	3575	3520	3466	3413	3360	3308	3257	3206	3156	3106	3057	2
3	3629	3574	3519	3465	3412	3359	3307	3256	3205	3155	3105	3056	3
4	3628	3573	3518	3464	3411	3358	3306	3255	3204	3154	3105	3056	4
5	3627	3572	3517	3463	3410	3358	3306	3254	3204	3153	3104	3055	5
6	3626	3571	3516	3463	3409	3357	3305	3253	3203	3153	3103	3054	6
7	3625	3570	3515	3462	3408	3356	3304	3253	3202	3152	3102	3053	7
8	3624	3569	3514	3461	3408	3355	3303	3252	3201	3151	3101	3052	8
9	3623	3568	3514	3460	3407	3354	3302	3251	3200	3150	3101	3052	9
10	3623	3567	3513	3459	3406	3353	3301	3250	3199	3149	3100	3051	10
11	3622	3566	3512	3458	3405	3352	3300	3249	3198	3148	3099	3050	11
12	3621	3565	3511	3457	3404	3351	3300	3248	3198	3148	3098	3049	12
13	3620	3565	3510	3456	3403	3351	3299	3247	3197	3147	3097	3048	13
14	3619	3564	3509	3455	3402	3350	3298	3247	3196	3146	3096	3047	14
15	3618	3563	3508	3454	3401	3349	3297	3246	3195	3145	3096	3047	15
16	3617	3562	3507	3454	3400	3348	3296	3245	3194	3144	3095	3046	16
17	3616	3561	3506	3453	3400	3347	3295	3244	3193	3143	3094	3045	17
18	3615	3560	3506	3452	3399	3346	3294	3243	3193	3143	3093	3044	18
19	3614	3559	3505	3451	3398	3345	3294	3242	3192	3142	3092	3043	19
20	3613	3558	3504	3450	3397	3345	3293	3242	3191	3141	3091	3043	20
21	3612	3557	3503	3449	3396	3344	3292	3241	3190	3140	3091	3042	21
22	3611	3556	3502	3448	3395	3343	3291	3240	3189	3139	3090	3041	22
23	3610	3555	3501	3447	3394	3342	3290	3239	3188	3138	3089	3040	23
24	3610	3555	3500	3446	3393	3341	3289	3238	3188	3138	3088	3039	24
25	3609	3554	3499	3446	3393	3340	3288	3237	3187	3137	3087	3039	25
26	3608	3553	3498	3445	3392	3339	3288	3236	3186	3136	3087	3038	26
27	3607	3552	3497	3444	3391	3338	3287	3236	3185	3135	3086	3037	27
28	3606	3551	3497	3443	3390	3338	3286	3235	3184	3134	3085	3036	28
29	3605	3550	3496	3442	3389	3337	3285	3234	3183	3133	3084	3035	29
30	3604	3549	3495	3441	3388	3336	3284	3233	3183	3133	3083	3034	30
31	3603	3548	3494	3440	3387	3335	3283	3232	3182	3132	3082	3034	31
32	3602	3547	3493	3439	3386	3334	3282	3231	3181	3131	3082	3033	32
33	3601	3546	3492	3438	3386	3333	3282	3231	3180	3130	3081	3032	33
34	3600	3545	3491	3438	3385	3332	3281	3230	3179	3129	3080	3031	34
35	3599	3545	3490	3437	3384	3332	3280	3229	3178	3129	3079	3030	35
36	3598	3544	3489	3436	3383	3331	3279	3228	3178	3128	3078	3030	36
37	3598	3543	3488	3435	3382	3330	3278	3227	3177	3127	3078	3029	37
38	3597	3542	3488	3434	3381	3329	3277	3226	3176	3126	3077	3028	38
39	3596	3541	3487	3433	3380	3328	3276	3225	3175	3125	3076	3027	39
40	3595	3540	3486	3432	3379	3327	3276	3225	3174	3124	3075	3026	40
41	3594	3539	3485	3431	3379	3326	3275	3224	3173	3124	3074	3026	41
42	3593	3538	3484	3431	3378	3325	3274	3223	3173	3123	3073	3025	42
43	3592	3537	3483	3430	3377	3325	3273	3222	3172	3122	3073	3024	43
44	3591	3536	3482	3429	3376	3324	3272	3221	3171	3121	3072	3023	44
45	3590	3535	3481	3428	3375	3323	3271	3220	3170	3120	3071	3022	45
46	3589	3535	3480	3427	3374	3322	3270	3220	3169	3119	3070	3022	46
47	3588	3534	3480	3426	3373	3321	3270	3219	3168	3119	3069	3021	47
48	3587	3533	3479	3425	3372	3320	3269	3218	3168	3118	3069	3020	48
49	3587	3532	3478	3424	3372	3319	3268	3217	3167	3117	3068	3019	49
50	3586	3531	3477	3423	3371	3319	3267	3216	3166	3116	3067	3018	50
51	3585	3530	3476	3423	3370	3318	3266	3215	3165	3115	3066	3018	51
52	3584	3529	3475	3422	3369	3317	3265	3214	3164	3114	3065	3017	52
53	3583	3528	3474	3421	3368	3316	3265	3214	3163	3114	3065	3016	53
54	3582	3527	3473	3420	3367	3315	3264	3213	3163	3113	3064	3015	54
55	3581	3526	3472	3419	3366	3314	3263	3212	3162	3112	3063	3014	55
56	3580	3525	3471	3418	3365	3313	3262	3211	3161	3111	3062	3014	56
57	3579	3525	3471	3417	3365	3313	3261	3210	3160	3110	3061	3013	57
58	3578	3524	3470	3416	3364	3312	3260	3209	3159	3110	3060	3012	58
59	3577	3523	3469	3415	3363	3311	3259	3209	3158	3109	3060	3011	59
60	3576	3522	3468	3415	3362	3310	3259	3208	3158	3108	3059	3010	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 30′	h. m. 1° 31′	h. m. 1° 32′	h. m. 1° 33′	h. m. 1 34′	h. m. 1° 35′	h. m. 1° 36′	h. m. 1° 37′	h. m. 1° 38′	h. m. 1° 39′	h. m. 1° 40′	h. m. 1 41′	s. ″
0	3010	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	0
1	3009	2962	2914	2867	2821	2775	2729	2684	2640	2596	2552	2509	1
2	3009	2961	2913	2866	2820	2774	2729	2684	2639	2595	2551	2508	2
3	3008	2960	2912	2866	2819	2773	2728	2683	2638	2594	2551	2507	3
4	3007	2959	2912	2865	2818	2772	2727	2682	2638	2593	2550	2507	4
5	3006	2958	2911	2864	2318	2772	2726	2681	2637	2593	2549	2506	5
6	3005	2958	2910	2863	2817	2771	2725	2681	2636	2592	2548	2505	6
7	3005	2957	2909	2862	2816	2770	2725	2680	2635	2591	2548	2504	7
8	3004	2956	2909	2862	2815	2769	2724	2679	2635	2591	2547	2504	8
9	3003	2955	2908	2861	2815	2769	2723	2678	2634	2590	2546	2503	9
10	3002	2954	2907	2860	2814	2768	2722	2678	2633	2589	2545	2502	10
11	3001	2954	2906	2859	2813	2767	2722	2677	2632	2588	2545	2502	11
12	3001	2953	2905	2859	2812	2766	2721	2676	2632	2588	2544	2501	12
13	3000	2952	2905	2858	2811	2766	2720	2675	2631	2587	2543	2500	13
14	2999	2951	2904	2857	2811	2765	2719	2675	2630	2586	2543	2499	14
15	2998	2950	2903	2856	2810	2764	2719	2674	2629	2585	2542	2499	15
16	2997	2950	2902	2855	2809	2763	2718	2673	2629	2585	2541	2498	16
17	2997	2949	2901	2855	2808	2763	2717	2672	2628	2584	2540	2497	17
18	2996	2948	2901	2854	2808	2762	2716	2672	2627	2583	2540	2497	18
19	2995	2947	2900	2853	2807	2761	2716	2671	2626	2583	2539	2496	19
20	2994	2946	2899	2852	2806	2760	2715	2670	2626	2582	2538	2495	20
21	2993	2946	2898	2852	2805	2760	2714	2669	2625	2581	2538	2494	21
22	2993	2945	2898	2851	2805	2759	2713	2669	2624	2580	2537	2494	22
23	2992	2944	2897	2850	2804	2758	2713	2668	2624	2580	2536	2493	23
24	2991	2943	2896	2849	2803	2757	2712	2667	2623	2579	2535	2492	24
25	2990	2942	2895	2848	2802	2756	2711	2666	2622	2578	2535	2492	25
26	2989	2942	2894	2848	2801	2756	2710	2666	2621	2577	2534	2491	26
27	2989	2941	2894	2847	2801	2755	2710	2665	2621	2577	2533	2490	27
28	2988	2940	2893	2846	2800	2754	2709	2664	2620	2576	2533	2489	28
29	2987	2939	2892	2845	2799	2753	2708	2663	2619	2575	2532	2489	29
30	2986	2939	2891	2845	2798	2753	2707	2663	2618	2574	2531	2488	30
31	2985	2938	2891	2844	2798	2752	2707	2662	2618	2574	2530	2487	31
32	2985	2937	2890	2843	2797	2751	2706	2661	2617	2573	2530	2487	32
33	2984	2936	2889	2842	2796	2750	2705	2660	2616	2572	2529	2486	33
34	2983	2935	2888	2842	2795	2750	2704	2660	2615	2572	2528	2485	34
35	2982	2935	2887	2841	2795	2749	2704	2659	2615	2571	2527	2485	35
36	2981	2934	2887	2840	2794	2748	2703	2658	2614	2570	2527	2484	36
37	2981	2933	2886	2839	2793	2747	2702	2657	2613	2569	2526	2483	37
38	2980	2932	2885	2838	2792	2747	2701	2657	2612	2569	2525	2482	38
39	2979	2931	2884	2838	2792	2746	2701	2656	2612	2568	2525	2482	39
40	2978	2931	2883	2837	2791	2745	2700	2655	2611	2567	2524	2481	40
41	2977	2930	2883	2836	2790	2744	2699	2655	2610	2566	2523	2480	41
42	2977	2929	2882	2835	2789	2744	2698	2654	2610	2566	2522	2480	42
43	2976	2928	2881	2835	2788	2743	2698	2653	2609	2565	2522	2479	43
44	2975	2927	2880	2834	2788	2742	2697	2652	2608	2564	2521	2478	44
45	2974	2927	2880	2833	2787	2741	2696	2652	2607	2564	2520	2477	45
46	2973	2926	2879	2832	2786	2741	2695	2651	2607	2563	2520	2477	46
47	2973	2925	2878	2831	2785	2740	2695	2650	2606	2562	2519	2476	47
48	2972	2924	2877	2831	2785	2739	2694	2649	2605	2561	2518	2475	48
49	2971	2924	2876	2830	2784	2738	2693	2649	2604	2561	2517	2475	49
50	2970	2923	2876	2829	2783	2738	2692	2648	2604	2560	2517	2474	50
51	2969	2922	2875	2828	2782	2737	2692	2647	2603	2559	2516	2473	51
52	2969	2921	2874	2828	2782	2736	2691	2646	2602	2559	2515	2472	52
53	2968	2920	2873	2827	2781	2735	2690	2646	2601	2558	2515	2472	53
54	2967	2920	2873	2826	2780	2735	2689	2645	2601	2557	2514	2471	54
55	2966	2919	2872	2825	2779	2734	2689	2644	2600	2556	2513	2470	55
56	2965	2918	2871	2825	2779	2733	2688	2643	2599	2556	2512	2470	56
57	2965	2917	2870	2824	2778	2732	2687	2643	2599	2555	2512	2469	57
58	2964	2916	2869	2823	2777	2732	2687	2642	2598	2554	2511	2468	58
59	2963	2916	2869	2822	2776	2731	2686	2641	2597	2553	2510	2467	59
60	2962	2915	2868	2821	2775	2730	2685	2640	2596	2553	2510	2467	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 42′	h. m. 1° 43′	h. m. 1° 44′	h. m. 1° 45′	h. m. 1 46′	h. m. 1° 47′	h. m. 1° 48′	h. m. 1° 49′	h. m. 1° 50′	h. m. 1° 51′	h. m. 1° 52′	h. m. 1 53′	s. ″
0	2467	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	0
1	2466	2424	2382	2340	2299	2258	2218	2178	2138	2099	2060	2021	1
2	2465	2423	2381	2339	2298	2258	2217	2177	2137	2098	2059	2021	2
3	2465	2422	2380	2339	2298	2257	2216	2176	2137	2098	2059	2020	3
4	2464	2422	2380	2338	2297	2256	2216	2176	2136	2097	2058	2019	4
5	2463	2421	2379	2337	2296	2256	2215	2175	2136	2096	2057	2019	5
6	2462	2420	2378	2337	2296	2255	2214	2174	2135	2096	2057	2018	6
7	2462	2419	2378	2336	2295	2254	2214	2174	2134	2095	2056	2017	7
8	2461	2419	2377	2335	2294	2253	2213	2173	2134	2094	2055	2017	8
9	2460	2418	2376	2335	2294	2253	2212	2172	2133	2094	2055	2016	9
10	2460	2417	2375	2334	2293	2252	2212	2172	2132	2093	2054	2016	10
11	2459	2417	2375	2333	2292	2251	2211	2171	2132	2092	2053	2015	11
12	2458	2416	2374	2333	2291	2251	2210	2170	2131	2092	2053	2014	12
13	2458	2415	2373	2332	2291	2250	2210	2170	2130	2091	2052	2014	13
14	2457	2415	2373	2331	2290	2249	2209	2169	2130	2090	2052	2013	14
15	2456	2414	2372	2331	2289	2249	2208	2169	2129	2090	2051	2012	15
16	2455	2413	2371	2330	2289	2248	2208	2168	2128	2089	2050	2012	16
17	2455	2412	2371	2329	2288	2247	2207	2167	2128	2088	2050	2011	17
18	2454	2412	2370	2328	2287	2247	2206	2167	2127	2088	2049	2010	18
19	2453	2411	2369	2328	2287	2246	2206	2166	2126	2087	2048	2010	19
20	2453	2410	2368	2327	2286	2245	2205	2165	2126	2086	2048	2009	20
21	2452	2410	2368	2326	2285	2245	2204	2165	2125	2086	2047	2009	21
22	2451	2409	2367	2326	2285	2244	2204	2164	2124	2085	2046	2008	22
23	2450	2408	2366	2325	2284	2243	2203	2163	2124	2085	2046	2007	23
24	2450	2408	2366	2324	2283	2243	2202	2163	2123	2084	2045	2007	24
25	2449	2407	2365	2324	2283	2242	2202	2162	2122	2083	2044	2006	25
26	2448	2406	2364	2323	2282	2241	2201	2161	2122	2083	2044	2005	26
27	2448	2405	2364	2322	2281	2241	2200	2161	2121	2082	2043	2005	27
28	2447	2405	2363	2322	2281	2240	2200	2160	2120	2081	2042	2004	28
29	2446	2404	2362	2321	2280	2239	2199	2159	2120	2081	2042	2003	29
30	2445	2403	2362	2320	2279	2239	2198	2159	2119	2080	2041	2003	30
31	2445	2403	2361	2320	2279	2238	2198	2158	2118	2079	2041	2002	31
32	2444	2402	2360	2319	2278	2237	2197	2157	2118	2079	2040	2001	32
33	2443	2401	2359	2318	2277	2237	2196	2157	2117	2078	2039	2001	33
34	2443	2401	2359	2317	2277	2236	2196	2156	2116	2077	2039	2000	34
35	2442	2400	2358	2317	2276	2235	2195	2155	2116	2077	2038	2000	35
36	2441	2399	2357	2316	2275	2235	2194	2155	2115	2076	2037	1999	36
37	2441	2398	2357	2315	2274	2234	2194	2154	2115	2075	2037	1998	37
38	2440	2398	2356	2315	2274	2233	2193	2153	2114	2075	2036	1998	38
39	2439	2397	2355	2314	2273	2233	2192	2153	2113	2074	2035	1997	39
40	2438	2396	2355	2313	2272	2232	2192	2152	2113	2073	2035	1996	40
41	2438	2396	2354	2313	2272	2231	2191	2151	2112	2073	2034	1996	41
42	2437	2395	2353	2312	2271	2231	2190	2151	2111	2072	2033	1995	42
43	2436	2394	2353	2311	2270	2230	2190	2150	2111	2072	2033	1994	43
44	2436	2394	2352	2311	2270	2229	2189	2149	2110	2071	2032	1994	44
45	2435	2393	2351	2310	2269	2229	2188	2149	2109	2070	2032	1993	45
46	2434	2392	2350	2309	2268	2228	2188	2148	2109	2070	2031	1993	46
47	2433	2391	2350	2309	2268	2227	2187	2147	2108	2069	2030	1992	47
48	2433	2391	2349	2308	2267	2227	2186	2147	2107	2068	2030	1991	48
49	2432	2390	2348	2307	2266	2226	2186	2146	2107	2068	2029	1991	49
50	2431	2389	2348	2307	2266	2225	2185	2145	2106	2067	2028	1990	50
51	2431	2389	2347	2306	2265	2225	2184	2145	2105	2066	2028	1989	51
52	2430	2388	2346	2305	2264	2224	2184	2144	2105	2066	2027	1989	52
53	2429	2387	2346	2304	2264	2223	2183	2143	2104	2065	2026	1988	53
54	2429	2387	2345	2304	2263	2223	2182	2143	2103	2064	2026	1987	54
55	2428	2386	2344	2303	2262	2222	2182	2142	2103	2064	2025	1987	55
56	2427	2385	2344	2302	2262	2221	2181	2141	2102	2063	2025	1986	56
57	2426	2384	2343	2302	2261	2220	2180	2141	2101	2062	2024	1986	57
58	2426	2384	2342	2301	2260	2220	2180	2140	2101	2062	2023	1985	58
59	2425	2383	2342	2300	2260	2219	2179	2139	2100	2061	2023	1984	59
60	2424	2382	2341	2300	2259	2218	2178	2139	2099	2061	2022	1984	60

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 1° 54′	h. m. 1° 55′	h. m. 1° 56′	h. m. 1° 57′	h. m. 1 58′	h. m. 1° 59′	h. m. 2° 0′	h. m. 2° 1′	h. m. 2° 2′	h. m. 2° 3′	h. m. 2° 4′	s. ″
0	1984	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	0
1	1983	1945	1908	1870	1833	1797	1760	1724	1689	1653	1618	1
2	1982	1944	1907	1870	1833	1796	1760	1724	1688	1652	1617	2
3	1982	1944	1906	1869	1832	1795	1759	1723	1687	1652	1617	3
4	1981	1943	1906	1868	1831	1795	1759	1722	1687	1651	1616	4
5	1981	1943	1905	1868	1831	1794	1758	1722	1686	1651	1616	5
6	1980	1942	1904	1867	1830	1794	1757	1721	1686	1650	1615	6
7	1979	1941	1904	1867	1830	1793	1757	1721	1685	1650	1614	7
8	1979	1941	1903	1866	1829	1792	1756	1720	1684	1649	1614	8
9	1978	1940	1903	1865	1828	1792	1755	1719	1684	1648	1613	9
10	1977	1939	1902	1865	1828	1791	1755	1719	1683	1648	1613	10
11	1977	1939	1901	1864	1827	1791	1754	1718	1683	1647	1612	11
12	1976	1938	1901	1863	1827	1790	1754	1718	1682	1647	1612	12
13	1975	1938	1900	1863	1826	1789	1753	1717	1681	1646	1611	13
14	1975	1937	1899	1862	1825	1789	1752	1717	1681	1645	1610	14
15	1974	1936	1899	1862	1825	1788	1752	1716	1680	1645	1610	15
16	1974	1936	1898	1861	1824	1788	1751	1715	1680	1644	1609	16
17	1973	1935	1898	1860	1823	1787	1751	1715	1679	1644	1609	17
18	1972	1934	1897	1860	1823	1786	1750	1714	1678	1643	1608	18
19	1972	1934	1896	1859	1822	1786	1749	1714	1678	1643	1607	19
20	1971	1933	1896	1859	1822	1785	1749	1713	1677	1642	1607	20
21	1970	1933	1895	1858	1821	1785	1748	1712	1677	1641	1606	21
22	1970	1932	1894	1857	1820	1784	1748	1712	1676	1641	1606	22
23	1969	1931	1894	1857	1820	1783	1747	1711	1676	1640	1605	23
24	1968	1931	1893	1856	1819	1783	1746	1711	1675	1640	1605	24
25	1968	1930	1893	1855	1819	1782	1746	1710	1674	1639	1604	25
26	1967	1929	1892	1855	1818	1781	1745	1709	1674	1638	1603	26
27	1967	1929	1891	1854	1817	1781	1745	1709	1673	1638	1603	27
28	1966	1928	1891	1854	1817	1780	1744	1708	1673	1637	1602	28
29	1965	1928	1890	1853	1816	1780	1743	1708	1672	1637	1602	29
30	1965	1927	1889	1852	1816	1779	1743	1707	1671	1636	1601	30
31	1964	1926	1889	1852	1815	1778	1742	1706	1671	1635	1600	31
32	1963	1926	1888	1851	1814	1778	1742	1706	1670	1635	1600	32
33	1963	1925	1888	1850	1814	1777	1741	1705	1670	1634	1599	33
34	1962	1924	1887	1850	1813	1777	1740	1705	1669	1634	1599	34
35	1962	1924	1886	1849	1812	1776	1740	1704	1668	1633	1598	35
36	1961	1923	1886	1849	1812	1775	1739	1703	1668	1633	1598	36
37	1960	1923	1885	1848	1811	1775	1739	1703	1667	1632	1597	37
38	1960	1922	1884	1847	1811	1774	1738	1702	1667	1631	1596	38
39	1959	1921	1884	1847	1810	1774	1737	1702	1666	1631	1596	39
40	1958	1921	1883	1846	1809	1773	1737	1701	1665	1630	1595	40
41	1958	1920	1883	1846	1809	1772	1736	1700	1665	1630	1595	41
42	1957	1919	1882	1845	1808	1772	1736	1700	1664	1629	1594	42
43	1956	1919	1881	1844	1808	1771	1735	1699	1664	1628	1593	43
44	1956	1918	1881	1844	1807	1771	1734	1699	1663	1628	1593	44
45	1955	1918	1880	1843	1806	1770	1734	1698	1663	1627	1592	45
46	1955	1917	1880	1843	1806	1769	1733	1697	1662	1627	1592	46
47	1954	1916	1879	1842	1805	1769	1733	1697	1661	1626	1591	47
48	1953	1916	1878	1841	1805	1768	1732	1696	1661	1626	1591	48
49	1953	1915	1878	1841	1804	1768	1731	1696	1660	1625	1590	49
50	1952	1914	1877	1840	1803	1767	1731	1695	1660	1624	1589	50
51	1951	1914	1876	1839	1803	1766	1730	1694	1659	1624	1589	51
52	1951	1913	1876	1839	1802	1766	1730	1694	1658	1623	1588	52
53	1950	1913	1875	1838	1802	1765	1729	1693	1658	1623	1588	53
54	1950	1912	1875	1838	1801	1765	1728	1693	1657	1622	1587	54
55	1949	1911	1874	1837	1800	1764	1728	1692	1657	1621	1587	55
56	1948	1911	1873	1836	1800	1763	1727	1692	1656	1621	1586	56
57	1948	1910	1873	1836	1799	1763	1727	1691	1655	1620	1585	57
58	1947	1909	1872	1835	1798	1762	1726	1690	1655	1620	1585	58
59	1946	1909	1871	1835	1798	1762	1725	1690	1654	1619	1584	59
60	1946	1908	1871	1834	1797	1761	1725	1689	1654	1619	1584	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 5′	h. m. 2° 6′	h. m. 2° 7′	h. m. 2° 8′	h. m. 2° 9′	h. m. 2° 10′	h. m. 2° 11′	h. m. 2° 12′	h. m. 2° 13′	h. m. 2° 14′	h. m. 2° 15′	s. ″
0	1584	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	0
1	1583	1548	1514	1480	1446	1413	1379	1346	1314	1281	1249	1
2	1582	1548	1514	1479	1446	1412	1379	1346	1313	1281	1248	2
3	1582	1547	1513	1479	1445	1412	1378	1345	1313	1280	1248	3
4	1581	1547	1512	1478	1445	1411	1378	1345	1312	1280	1247	4
5	1581	1546	1512	1478	1444	1411	1377	1344	1311	1279	1247	5
6	1580	1546	1511	1477	1443	1410	1377	1344	1311	1278	1246	6
7	1580	1545	1511	1477	1443	1409	1376	1343	1310	1278	1246	7
8	1579	1544	1510	1476	1442	1409	1376	1343	1310	1277	1245	8
9	1578	1544	1510	1476	1442	1408	1375	1342	1309	1277	1245	9
10	1578	1543	1509	1475	1441	1408	1374	1342	1309	1276	1244	10
11	1577	1543	1508	1474	1441	1407	1374	1341	1308	1276	1243	11
12	1577	1542	1508	1474	1440	1407	1373	1340	1308	1275	1243	12
13	1576	1542	1507	1473	1440	1406	1373	1340	1307	1275	1242	13
14	1576	1541	1507	1473	1439	1406	1372	1339	1307	1274	1242	14
15	1575	1540	1506	1472	1438	1405	1372	1339	1306	1274	1241	15
16	1574	1540	1506	1472	1438	1404	1371	1338	1306	1273	1241	16
17	1574	1539	1505	1471	1437	1404	1371	1338	1305	1273	1240	17
18	1573	1539	1504	1470	1437	1403	1370	1337	1304	1272	1240	18
19	1573	1538	1504	1470	1436	1403	1370	1337	1304	1271	1239	19
20	1572	1538	1503	1469	1436	1402	1369	1336	1303	1271	1239	20
21	1571	1537	1503	1469	1435	1402	1368	1335	1303	1270	1238	21
22	1571	1536	1502	1468	1435	1401	1368	1335	1302	1270	1238	22
23	1570	1536	1502	1468	1434	1401	1367	1334	1302	1269	1237	23
24	1570	1535	1501	1467	1433	1400	1367	1334	1301	1269	1237	24
25	1569	1535	1500	1467	1433	1399	1366	1333	1301	1268	1236	25
26	1569	1534	1500	1466	1432	1399	1366	1333	1300	1268	1235	26
27	1568	1534	1499	1465	1432	1398	1365	1332	1300	1267	1235	27
28	1567	1533	1499	1465	1431	1398	1365	1332	1299	1267	1234	28
29	1567	1532	1498	1464	1431	1397	1364	1331	1298	1266	1234	29
30	1566	1532	1498	1464	1430	1397	1363	1331	1298	1266	1233	30
31	1566	1531	1497	1463	1429	1396	1363	1330	1297	1265	1233	31
32	1565	1531	1496	1463	1429	1396	1362	1329	1297	1264	1232	32
33	1565	1530	1496	1462	1428	1395	1362	1329	1296	1264	1232	33
34	1564	1530	1495	1461	1428	1394	1361	1328	1296	1263	1231	34
35	1563	1529	1495	1461	1427	1394	1361	1328	1295	1263	1231	35
36	1563	1528	1494	1460	1427	1393	1360	1327	1295	1262	1230	36
37	1562	1528	1494	1460	1426	1393	1360	1327	1294	1262	1230	37
38	1562	1527	1493	1459	1426	1392	1359	1326	1294	1261	1229	38
39	1561	1527	1493	1459	1425	1392	1359	1326	1293	1261	1229	39
40	1561	1526	1492	1458	1424	1391	1358	1325	1292	1260	1228	40
41	1560	1526	1491	1458	1424	1391	1357	1325	1292	1260	1227	41
42	1559	1525	1491	1457	1423	1390	1357	1324	1291	1259	1227	42
43	1559	1524	1490	1456	1423	1389	1356	1323	1291	1259	1226	43
44	1558	1524	1490	1456	1422	1389	1356	1323	1290	1258	1226	44
45	1558	1523	1489	1455	1422	1388	1355	1322	1290	1257	1225	45
46	1557	1523	1489	1455	1421	1388	1355	1322	1289	1257	1225	46
47	1556	1522	1488	1454	1421	1387	1354	1321	1289	1256	1224	47
48	1556	1522	1487	1454	1420	1387	1354	1321	1288	1256	1224	48
49	1555	1521	1487	1453	1419	1386	1353	1320	1288	1255	1223	49
50	1555	1520	1486	1452	1419	1386	1352	1320	1287	1255	1223	50
51	1554	1520	1486	1452	1418	1385	1352	1319	1287	1254	1222	51
52	1554	1519	1485	1451	1418	1384	1351	1319	1286	1254	1222	52
53	1553	1519	1485	1451	1417	1384	1351	1318	1285	1253	1221	53
54	1552	1518	1484	1450	1417	1383	1350	1317	1285	1253	1221	54
55	1552	1518	1483	1450	1416	1383	1350	1317	1284	1252	1220	55
56	1551	1517	1483	1449	1416	1382	1349	1316	1284	1252	1219	56
57	1551	1516	1482	1449	1415	1382	1349	1316	1283	1251	1219	57
58	1550	1516	1482	1448	1414	1381	1348	1315	1283	1250	1218	58
59	1550	1515	1481	1447	1414	1381	1348	1315	1282	1250	1218	59
60	1549	1515	1481	1447	1413	1380	1347	1314	1282	1249	1217	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 16′	h. m. 2° 17′	h. m. 2° 18′	h. m. 2° 19′	h. m. 2 20′	h. m. 2° 21′	h. m. 2° 22′	h. m. 2° 23′	h. m. 2° 24′	h. m. 2° 25′	h. m. 2 26′	s. ″
0	1217	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0
1	1217	1185	1153	1122	1091	1060	1029	0999	0969	0939	0909	1
2	1216	1184	1153	1122	1090	1060	1029	0998	0968	0938	0908	2
3	1216	1184	1152	1121	1090	1059	1028	0998	0968	0938	0908	3
4	1215	1183	1152	1120	1089	1058	1028	0997	0967	0937	0907	4
5	1215	1183	1151	1120	1089	1058	1027	0997	0967	0937	0907	5
6	1214	1182	1151	1119	1088	1057	1027	0996	0966	0936	0906	6
7	1214	1182	1150	1119	1088	1057	1026	0996	0966	0936	0906	7
8	1213	1181	1150	1118	1087	1056	1026	0995	0965	0935	0905	8
9	1213	1181	1149	1118	1087	1056	1025	0995	0965	0935	0905	9
10	1212	1180	1149	1117	1086	1055	1025	0994	0964	0934	0904	10
11	1211	1180	1148	1117	1086	1055	1024	0994	0964	0934	0904	11
12	1211	1179	1148	1116	1085	1054	1024	0993	0963	0933	0903	12
13	1210	1179	1147	1116	1085	1054	1023	0993	0963	0933	0903	13
14	1210	1178	1147	1115	1084	1053	1023	0992	0962	0932	0902	14
15	1209	1178	1146	1115	1084	1053	1022	0992	0962	0932	0902	15
16	1209	1177	1146	1114	1083	1052	1022	0991	0961	0931	0901	16
17	1208	1177	1145	1114	1083	1052	1021	0991	0961	0931	0901	17
18	1208	1176	1145	1113	1082	1051	1021	0990	0960	0930	0900	18
19	1207	1175	1144	1113	1082	1051	1020	0990	0960	0930	0900	19
20	1207	1175	1143	1112	1081	1050	1020	0989	0959	0929	0899	20
21	1206	1174	1143	1112	1081	1050	1019	0989	0959	0929	0899	21
22	1206	1174	1142	1111	1080	1049	1019	0988	0958	0928	0898	22
23	1205	1173	1142	1111	1080	1049	1018	0988	0958	0928	0898	23
24	1205	1173	1141	1110	1079	1048	1018	0987	0957	0927	0897	24
25	1204	1172	1141	1110	1079	1048	1017	0987	0957	0927	0897	25
26	1204	1172	1140	1109	1078	1047	1017	0986	0956	0926	0896	26
27	1203	1171	1140	1109	1078	1047	1016	0986	0956	0926	0896	27
28	1202	1171	1139	1108	1077	1046	1016	0985	0955	0925	0895	28
29	1202	1170	1139	1108	1076	1046	1015	0985	0955	0925	0895	29
30	1201	1170	1138	1107	1076	1045	1015	0984	0954	0924	0894	30
31	1201	1169	1138	1106	1075	1045	1014	0984	0954	0924	0894	31
32	1200	1169	1137	1106	1075	1044	1014	0983	0953	0923	0893	32
33	1200	1168	1137	1105	1074	1044	1013	0983	0953	0923	0893	33
34	1199	1168	1136	1105	1074	1043	1013	0982	0952	0922	0892	34
35	1199	1167	1136	1104	1073	1043	1012	0982	0952	0922	0892	35
36	1198	1167	1135	1104	1073	1042	1012	0981	0951	0921	0891	36
37	1198	1166	1135	1103	1072	1042	1011	0981	0951	0921	0891	37
38	1197	1165	1134	1103	1072	1041	1011	0980	0950	0920	0890	38
39	1197	1165	1134	1102	1071	1041	1010	0980	0950	0920	0890	39
40	1196	1164	1133	1102	1071	1040	1009	0979	0949	0919	0889	40
41	1196	1164	1132	1101	1070	1040	1009	0979	0949	0919	0889	41
42	1195	1163	1132	1101	1070	1039	1008	0978	0948	0918	0888	42
43	1195	1163	1131	1100	1069	1039	1008	0978	0948	0918	0888	43
44	1194	1162	1131	1100	1069	1038	1007	0977	0947	0917	0887	44
45	1193	1162	1130	1099	1068	1037	1007	0977	0947	0917	0887	45
46	1193	1161	1130	1099	1068	1037	1006	0976	0946	0916	0886	46
47	1192	1161	1129	1098	1067	1036	1006	0976	0946	0916	0886	47
48	1192	1160	1129	1098	1067	1036	1005	0975	0945	0915	0885	48
49	1191	1160	1128	1097	1066	1035	1005	0975	0945	0915	0885	49
50	1191	1159	1128	1097	1066	1035	1004	0974	0944	0914	0884	50
51	1190	1159	1127	1096	1065	1034	1004	0974	0944	0914	0884	51
52	1190	1158	1127	1096	1065	1034	1003	0973	0943	0913	0883	52
53	1189	1158	1126	1095	1064	1033	1003	0973	0943	0913	0883	53
54	1189	1157	1126	1095	1064	1033	1002	0972	0942	0912	0883	54
55	1188	1157	1125	1094	1063	1032	1002	0972	0942	0912	0882	55
56	1188	1156	1125	1094	1063	1032	1001	0971	0941	0911	0882	56
57	1187	1156	1124	1093	1062	1031	1001	0971	0941	0911	0881	57
58	1187	1155	1124	1092	1062	1031	1000	0970	0940	0910	0881	58
59	1186	1154	1123	1092	1061	1030	1000	0970	0940	0910	0880	59
60	1186	1154	1123	1091	1061	1030	0999	0969	0939	0909	0889	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 27′	h. m. 2° 28′	h. m. 2° 29′	h. m. 2° 30′	h. m. 2° 31′	h. m. 2° 32′	h. m. 2° 33′	h. m. 2° 34′	h. m. 2° 35′	h. m. 2 36	h. m. 2 37′	s. ″
0	0880	0850	0821	0792	0763	0734	0706	0678	0649	0621	0594	0
1	0879	0850	0820	0791	0762	0734	0705	0677	0649	0621	0593	1
2	0879	0849	0820	0791	0762	0733	0705	0677	0648	0621	0593	2
3	0878	0849	0819	0790	0762	0733	0704	0676	0648	0620	0592	3
4	0878	0848	0819	0790	0761	0732	0704	0676	0648	0620	0592	4
5	0877	0848	0818	0789	0761	0732	0703	0675	0647	0619	0591	5
6	0877	0847	0818	0789	0760	0731	0703	0675	0647	0619	0591	6
7	0876	0847	0817	0788	0760	0731	0703	0674	0646	9618	0591	7
8	0876	0846	0817	0788	0759	0730	0702	0674	0646	0618	0590	8
9	0875	0846	0816	0787	0759	0730	0702	0673	0645	0617	0590	9
10	0875	0845	0816	0787	0758	0730	0701	0673	0645	0617	0589	10
11	0874	0845	0816	0787	0758	0729	0701	0672	0644	0616	0589	11
12	0874	0844	0815	0786	0757	0729	0700	0672	0644	0616	0588	12
13	0873	0844	0815	0786	0757	0728	0700	0671	0643	0615	0588	13
14	0873	0843	0814	0785	0756	0728	0699	0671	0643	0615	0587	14
15	0872	0843	0814	0785	0756	0727	0699	0670	0642	0615	0587	15
16	0872	0842	0813	0784	0755	0727	0698	0670	0642	0614	0586	16
17	0871	0812	0813	0784	0755	0726	0698	0670	0641	0614	0586	17
18	0871	0841	0812	0783	0754	0726	0697	0669	0641	0613	0585	18
19	0870	0841	0812	0783	0754	0725	0697	0669	0641	0613	0585	19
20	0870	0840	0811	0782	0753	0725	0696	0668	0640	0612	0585	20
21	0869	0840	0811	0782	0753	0724	0696	0668	0640	0612	0584	21
22	0869	0839	0810	0781	0752	0724	0695	0667	0639	0611	0584	22
23	0868	0839	0810	0781	0752	0723	0695	0667	0639	0611	0583	23
24	0868	0838	0809	0780	0751	0723	0695	0666	0638	0610	0583	24
25	0867	0838	0809	0780	0751	0722	0694	0666	0638	0610	0582	25
26	0867	0837	0808	0779	0751	0722	0694	0665	0637	0609	0582	26
27	0866	0837	0808	0779	0750	0721	0693	0665	0637	0609	0581	27
28	0866	0836	0807	0778	0750	0721	0693	0664	0636	0609	0581	28
29	0865	0836	0807	0778	0749	0721	0692	0664	0636	0608	0580	29
30	0865	0835	0806	0777	0749	0720	0692	0663	0635	0608	0580	30
31	0864	0835	0806	0777	0748	0720	0691	0663	0635	0607	0579	31
32	0864	0834	0805	0776	0748	0719	0691	0663	0634	0607	0579	32
33	0863	0834	0805	0776	0747	0719	0690	0662	0634	0606	0579	33
34	0863	0834	0804	0775	0747	0718	0690	0662	0634	0606	0578	34
35	0862	0833	0804	0775	0746	0718	0689	0661	0633	0605	0578	35
36	0862	0833	0803	0774	0746	0717	0689	0661	0633	0605	0577	36
37	0861	0832	0803	0774	0745	0717	0688	0660	0632	0604	0577	37
38	0861	0832	0802	0774	0745	0716	0688	0660	0632	0604	0576	38
39	0860	0831	0802	0773	0744	0716	0687	0659	0631	0603	0576	39
40	0860	0831	0801	0773	0744	0715	0687	0659	0631	0603	0575	40
41	0859	0830	0801	0772	0743	0715	0686	0658	0630	0602	0575	41
42	0859	0830	0801	0772	0743	0714	0686	0658	0630	0602	0574	42
43	0858	0829	0800	0771	0742	0714	0686	0657	0629	0602	0574	43
44	0858	0829	0800	0771	0742	0713	0685	0657	0629	0601	0573	44
45	0857	0828	0799	0770	0741	0713	0685	0656	0628	0601	0573	45
46	0857	0828	0799	0770	0741	0712	0684	0656	0628	0600	0573	46
47	0856	0827	0798	0769	0740	0712	0684	0655	0628	0600	0572	47
48	0856	0827	0798	0769	0740	0711	0683	0655	0627	0599	0572	48
49	0855	0826	0797	0768	0740	0711	0683	0655	0627	0599	0571	49
50	0855	0826	0797	0768	0739	0711	0682	0654	0626	0598	0571	50
51	0855	0825	0796	0767	0739	0710	0682	0654	0626	0598	0570	51
52	0854	0825	0796	0767	0738	0710	0681	0653	0625	0597	0570	52
53	0854	0824	0795	0766	0738	0709	0681	0653	0625	0597	0569	53
54	0853	0824	0795	0766	0737	0709	0680	0652	0624	0596	0569	54
55	0853	0823	0794	0765	0737	0708	0680	0652	0624	0596	0568	55
56	0852	0823	0794	0765	0736	0708	0679	0651	0623	0596	0568	56
57	0852	0822	0793	0764	0736	0707	0679	0651	0623	0595	0568	57
58	0851	0822	0793	0764	0735	0707	0678	0650	0622	0595	0567	58
59	0851	0821	0792	0763	0735	0706	0678	0650	0622	0594	0567	59
60	0850	0821	0792	0763	0734	0706	0678	0649	0621	0591	0566	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 38′	h. m. 2° 39′	h. m. 2° 40′	h. m. 2° 41′	h. m. 2° 42′	h. m. 2° 43′	h. m. 2° 44′	h. m. 2° 45′	h. m. 2° 46′	h. m. 2° 47	h. m. 2 48′	s. ″
0	0566	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0
1	0566	0538	0511	0184	0457	0130	0404	0377	0351	0325	0299	1
2	0565	0538	0511	0484	0457	0430	0403	0377	0351	0325	0299	2
3	0565	0537	0510	0483	0456	0430	0403	0377	0350	0324	0298	3
4	0564	0537	0510	0483	0456	0429	0403	0376	0350	0324	0298	4
5	0564	0536	0509	0482	0455	0429	0402	0376	0349	0323	0297	5
6	0563	0536	0509	0482	0455	0428	0402	0375	0319	0323	0297	6
7	0563	0536	0508	0481	0454	0428	0401	0375	0349	0323	0297	7
8	0562	0535	0508	0481	0454	0427	0401	0374	0318	0322	0296	8
9	0562	0535	0507	0480	0454	0427	0400	0374	0348	0322	0296	9
10	0562	0534	0507	0480	0453	0426	0400	0374	0347	0321	0295	10
11	0561	0534	0507	0480	0453	0426	0399	0373	0347	0321	0295	11
12	0561	0533	0506	0479	0452	0426	0399	0373	0346	0320	0294	12
13	0560	0533	0506	0479	0452	0425	0399	0372	0346	0320	0294	13
14	0560	0532	0505	0478	0451	0425	0398	0372	0346	0319	0294	14
15	0559	0532	0505	0478	0451	0124	0398	0371	0345	0319	0293	15
16	0559	0531	0501	0477	0450	0424	0397	0371	0345	0319	0293	16
17	0558	0531	0504	0477	0450	0423	0397	0370	0344	0318	0292	17
18	0558	0531	0503	0476	0450	0123	0396	0370	0344	0318	0292	18
19	0557	0530	0503	0476	0449	0122	0396	0370	0343	0317	0291	19
20	0557	0530	0502	0475	0449	0422	0395	0369	0343	0317	0291	20
21	0557	0529	0502	0475	0448	0122	0395	0369	0342	0316	0291	21
22	0556	0529	0502	0475	0448	0421	0395	0368	0342	0316	0290	22
23	0556	0528	0501	0474	0447	0421	0394	0368	0342	0316	0290	23
24	0555	0528	0501	0474	0447	0420	0394	0367	0341	0315	0289	24
25	0555	0527	0500	0473	0446	0420	0393	0367	0341	0315	0289	25
26	0554	0527	0500	0473	0446	0419	0393	0366	0340	0314	0288	26
27	0554	0526	0499	0472	0446	0419	0392	0366	0340	0314	0288	27
28	0553	0526	0499	0472	0445	0418	0392	0366	0339	0313	0288	28
29	0553	0526	0498	0471	0445	0418	0391	0365	0339	0313	0287	29
30	0552	0525	0498	0471	0444	0418	0391	0365	0339	0313	0287	30
31	0552	0525	0498	0471	0444	0417	0391	0364	0338	0312	0286	31
32	0552	0524	0497	0470	0443	0417	0390	0364	0338	0312	0286	32
33	0551	0524	0497	0470	0443	0416	0390	0363	0337	0311	0285	33
34	0551	0523	0496	0469	0442	0416	0389	0363	0337	0311	0285	34
35	0550	0523	0496	0469	0442	0415	0389	0363	0336	0310	0285	35
36	0550	0522	0495	0468	0442	0415	0388	0362	0336	0310	0284	36
37	0519	0522	0495	0468	0441	0414	0388	0362	0336	0310	0284	37
38	0549	0521	0494	0467	0441	0414	0388	0361	0335	0309	0283	38
39	0548	0521	0494	0467	0440	0414	0387	0361	0335	0309	0283	39
40	0548	0521	0493	0167	0440	0413	0387	0360	0334	0308	0282	40
41	0547	0520	0493	0466	0439	0413	0386	0360	0334	0308	0282	41
42	0547	0520	0493	0466	0439	0412	0386	0359	0333	0307	0282	42
43	0546	0519	0492	0165	0438	0412	0385	0359	0333	0307	0281	43
44	0546	0519	0492	0465	0438	0411	0385	0359	0333	0307	0281	44
45	0546	0518	0491	0464	0438	0411	0384	0358	0332	0306	0280	45
46	0545	0518	0491	0464	0437	0410	0384	0358	0332	0306	0280	46
47	0545	0517	0490	0463	0437	0410	0384	0357	0331	0305	0279	47
48	0544	0517	0490	0463	0436	0410	0383	0357	0331	0305	0279	48
49	0544	0517	0489	0462	0436	0409	0383	0356	0330	0304	0279	49
50	0543	0516	0489	0462	0435	0409	0382	0356	0330	0304	0278	50
51	0543	0516	0489	0162	0435	0408	0382	0356	0329	0304	0278	51
52	0542	0515	0488	0461	0434	0408	0381	0355	0329	0303	0277	52
53	0542	0515	0488	0461	0434	0407	0381	0355	0329	0303	0277	53
54	0541	0514	0487	0460	0434	0407	0381	0354	0328	0302	0276	54
55	0541	0514	0187	0460	0433	0406	0380	0354	0328	0302	0276	55
56	0541	0513	0486	0459	0433	0406	0380	0353	0327	0301	0276	56
57	0540	0513	0486	0459	0432	0406	0379	0353	0327	0301	0275	57
58	0540	0512	0485	0458	0132	0405	0379	0353	0326	0300	0275	58
59	0539	0512	0185	0458	0431	0405	0378	0352	0326	0300	0274	59
60	0539	0512	0484	0458	0431	0404	0378	0352	0326	0300	0274	60

TABLE XXXIV.

PROPORTIONAL LOGARITHMS.

s. ″	h. m. 2° 49′	h. m. 2° 50′	h. m. 2° 51′	h. m. 2° 52′	h. m. 2 53′	h. m. 2° 54′	h. m. 2° 55′	h. m. 2° 56′	h. m. 2° 57′	h. m. 2° 58′	h. m. 2 59′	s. ″
0	0274	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024	0
1	0273	0248	0222	0197	0172	0147	0122	0097	0073	0048	0024	1
2	0273	0247	0222	0197	0171	0146	0122	0097	0072	0048	0023	2
3	0273	0247	0221	0196	0171	0146	0121	0096	0072	0047	0023	3
4	0272	0247	0221	0196	0171	0146	0121	0096	0071	0047	0023	4
5	0272	0246	0221	0195	0170	0145	0120	0096	0071	0046	0022	5
6	0271	0246	0220	0195	0170	0145	0120	0095	0071	0046	0022	6
7	0271	0245	0220	0194	0169	0144	0119	0095	0070	0046	0021	7
8	0270	0245	0219	0194	0169	0144	0119	0094	0070	0045	0021	8
9	0270	0244	0219	0194	0169	0143	0119	0094	0069	0045	0021	9
10	0270	0244	0219	0193	0168	0143	0118	0093	0069	0044	0020	10
11	0269	0244	0218	0193	0168	0143	0118	0093	0068	0044	0020	11
12	0269	0243	0218	0192	0167	0142	0117	0093	0068	0044	0019	12
13	0268	0243	0217	0192	0167	0142	0117	0092	0068	0043	0019	13
14	0268	0242	0217	0192	0166	0141	0117	0092	0067	0043	0019	14
15	0267	0242	0216	0191	0166	0141	0116	0091	0067	0042	0018	15
16	0267	0241	0216	0191	0166	0141	0116	0091	0066	0042	0018	16
17	0267	0241	0216	0190	0165	0140	0115	0091	0066	0042	0017	17
18	0266	0241	0215	0190	0165	0140	0115	0090	0066	0041	0017	18
19	0266	0240	0215	0189	0164	0139	0114	0090	0065	0041	0017	19
20	0265	0240	0214	0189	0164	0139	0114	0089	0065	0040	0016	20
21	0265	0239	0214	0189	0163	0139	0114	0089	0064	0040	0016	21
22	0264	0239	0213	0188	0163	0138	0113	0089	0064	0040	0015	22
23	0264	0238	0213	0188	0163	0138	0113	0088	0064	0039	0015	23
24	0264	0238	0213	0187	0162	0137	0112	0088	0063	0039	0015	24
25	0263	0238	0212	0187	0162	0137	0112	0087	0063	0038	0014	25
26	0263	0237	0212	0187	0161	0136	0112	0087	0062	0038	0014	26
27	0262	0237	0211	0186	0161	0136	0111	0087	0062	0038	0013	27
28	0262	0236	0211	0186	0161	0136	0111	0086	0062	0037	0013	28
29	0261	0236	0211	0185	0160	0135	0110	0086	0061	0037	0012	29
30	0261	0235	0210	0185	0160	0135	0110	0085	0061	0036	0012	30
31	0261	0235	0210	0184	0159	0134	0110	0085	0060	0036	0012	31
32	0260	0235	0209	0184	0159	0134	0109	0084	0060	0036	0011	32
33	0260	0234	0209	0184	0158	0134	0109	0084	0060	0035	0011	33
34	0259	0234	0208	0183	0158	0133	0108	0084	0059	0035	0010	34
35	0259	0233	0208	0183	0158	0133	0108	0083	0059	0034	0010	35
36	0258	0233	0208	0182	0157	0132	0107	0083	0058	0034	0010	36
37	0258	0233	0207	0182	0157	0132	0107	0082	0058	0034	0009	37
38	0258	0232	0207	0181	0156	0131	0107	0082	0057	0033	0009	38
39	0257	0232	0206	0181	0156	0131	0106	0082	0057	0033	0008	39
40	0257	0231	0206	0181	0156	0131	0106	0081	0057	0032	0008	40
41	0256	0231	0205	0180	0155	0130	0105	0081	0056	0032	0008	41
42	0256	0230	0205	0180	0155	0130	0105	0080	0056	0031	0007	42
43	0255	0230	0205	0179	0154	0129	0105	0080	0055	0031	0007	43
44	0255	0230	0204	0179	0154	0129	0104	0080	0055	0031	0006	44
45	0255	0229	0204	0179	0153	0129	0104	0079	0055	0030	0006	45
46	0254	0229	0203	0178	0153	0128	0103	0079	0054	0030	0006	46
47	0254	0228	0203	0178	0153	0128	0103	0078	0054	0029	0005	47
48	0253	0228	0202	0177	0152	0127	0103	0078	0053	0029	0005	48
49	0253	0227	0202	0177	0152	0127	0102	0077	0053	0029	0004	49
50	0252	0227	0202	0176	0151	0126	0102	0077	0053	0028	0004	50
51	0252	0227	0201	0176	0151	0126	0101	0077	0052	0028	0004	51
52	0252	0226	0201	0176	0151	0126	0101	0076	0052	0027	0003	52
53	0251	0226	0200	0175	0150	0125	0100	0076	0051	0027	0003	53
54	0251	0225	0200	0175	0150	0125	0100	0075	0051	0027	0002	54
55	0250	0225	0200	0174	0149	0124	0100	0075	0051	0026	0002	55
56	0250	0224	0199	0174	0149	0124	0099	0075	0050	0026	0002	56
57	0250	0224	0199	0174	0148	0124	0099	0074	0050	0025	0001	57
58	0249	0224	0198	0173	0148	0123	0098	0074	0049	0025	0001	58
59	0249	0223	0198	0173	0148	0123	0098	0073	0049	0025	0000	59
60	0248	0223	0197	0172	0147	0122	0098	0073	0049	0024	0000	60

TABLE XXXV.

To correct the Apparent Distance of the MOON from the SUN, a STAR, &c. for the Effects of Parallax and Refraction.

Par. in Alt. or Dist.	APPARENT DISTANCE.																				
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0
8	3	3	3	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1
10	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2
11	6	5	5	5	4	4	4	3	3	3	3	3	3	2	2	2	2	2	2	2	2
12	7	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3	2	2	2	2
13	8	8	7	6	6	6	5	5	5	4	4	4	4	3	3	3	3	3	3	3	3
14	10	9	8	7	7	6	6	6	5	5	5	4	4	4	4	4	4	3	3	3	3
15	11	10	9	9	8	7	7	6	6	6	5	5	5	5	4	4	4	4	4	4	3
16	13	11	11	10	9	8	8	7	7	6	6	6	6	5	5	5	5	4	4	4	4
17	14	13	12	11	10	9	9	8	8	7	7	7	6	6	6	5	5	5	5	5	4
18	16	15	13	12	11	11	10	9	9	8	8	7	7	7	6	6	6	6	5	5	5
19	18	16	15	14	13	12	11	10	10	9	9	8	8	7	7	7	6	6	6	6	5
20	20	18	16	15	14	13	12	11	11	10	10	9	9	8	8	7	7	7	7	6	6
21	22	20	18	17	15	14	13	13	12	11	11	10	10	9	9	8	8	8	7	7	7
22	24	22	20	18	17	16	15	14	13	12	12	11	10	10	9	9	9	8	8	8	7
23	26	24	22	20	19	17	16	15	14	13	13	12	11	11	10	10	9	9	9	8	8
24	28	26	24	22	20	19	18	16	15	15	14	13	12	12	11	11	10	10	9	9	9
25	31	28	26	24	22	20	19	18	17	16	15	14	13	13	12	12	11	11	10	10	9
26	33	30	28	26	24	22	21	19	18	17	16	15	15	14	13	13	12	12	11	11	10
27	36	33	30	28	26	24	22	21	20	18	17	17	16	15	14	13	13	12	12	11	11
28	39	35	32	30	27	26	24	22	21	20	19	18	17	16	15	15	14	13	13	12	12
29	42	38	35	32	29	27	26	24	23	21	20	19	18	17	16	16	15	14	14	13	13
30	45	40	37	34	31	29	27	26	24	23	22	20	19	19	18	17	16	15	15	14	14
31	48	43	39	36	34	31	29	27	26	24	23	22	21	20	19	18	17	16	16	15	15
32	51	46	42	39	36	33	31	29	27	26	25	23	22	21	20	19	18	18	17	16	15
33	54	49	45	41	38	35	33	31	29	28	26	25	24	22	21	20	19	19	18	17	16
34	57	52	47	44	40	38	35	33	31	29	28	26	25	24	23	22	21	20	19	18	17
35	61	55	50	46	43	40	37	35	33	31	29	28	26	25	24	23	22	21	20	19	19
36	64	58	53	49	45	42	39	37	35	33	31	29	28	27	25	24	23	22	21	20	20
37	68	61	56	52	48	45	42	39	37	35	33	31	30	28	27	26	24	23	22	22	21
38	71	65	59	55	51	47	44	41	39	37	35	33	31	30	28	27	26	25	24	23	22
39	75	68	62	57	53	50	46	43	41	39	36	35	33	31	30	28	27	26	25	24	23
40	79	72	66	60	56	52	49	46	43	41	38	36	35	33	31	30	29	27	26	25	24
41	83	75	69	63	59	55	51	48	45	43	40	38	36	35	33	31	30	29	28	26	25
42	87	79	72	67	62	57	54	50	47	45	42	40	38	36	35	33	32	30	29	28	27
43	91	83	76	70	65	60	56	53	50	47	44	42	40	38	36	35	33	32	30	29	28
44	96	87	79	73	68	63	59	55	52	49	46	44	42	40	38	36	35	33	32	30	29
45	100	91	83	76	71	66	62	58	54	51	49	46	44	42	40	38	36	35	33	32	31
46	105	95	87	80	74	69	64	60	57	54	51	48	46	43	41	40	38	36	35	33	32
47	109	99	91	83	77	72	67	63	59	56	53	50	48	45	43	41	40	38	36	35	33
48	114	103	94	87	81	75	70	66	62	58	55	52	50	47	45	43	41	39	38	36	35
49	119	108	98	91	84	78	73	68	64	61	58	55	52	49	47	45	43	41	39	38	36
50	124	112	103	94	87	81	76	71	67	63	60	57	54	51	49	47	45	43	41	39	38
51	128	117	107	98	91	85	79	74	70	66	62	59	56	53	51	49	47	45	43	41	39
52	134	121	111	102	95	88	82	77	73	68	65	61	58	56	53	51	48	46	44	43	41
53	139	126	115	106	98	91	85	80	75	71	67	64	61	58	55	53	50	48	46	44	42
54	144	131	120	110	102	95	89	83	78	74	70	66	63	60	57	55	52	50	48	46	44
55	149	136	124	114	106	98	92	86	81	77	72	69	65	62	59	57	54	52	50	48	46
56	155	141	129	118	110	102	95	89	84	79	75	71	68	64	61	59	56	54	51	49	47
57	160	146	133	123	114	106	99	93	87	82	78	74	70	67	64	61	58	56	53	51	49
58	166	151	138	127	118	109	102	96	90	85	81	76	73	69	66	63	60	58	55	53	51
59	172	156	143	131	122	113	106	99	93	88	83	79	75	72	68	65	62	60	57	55	53
60	178	161	148	136	126	117	109	103	97	91	86	82	78	74	71	67	64	62	59	57	54
61	184	167	152	140	130	121	113	106	100	94	89	85	80	76	73	70	67	64	61	59	56
62	190	172	158	145	134	125	117	110	103	97	92	87	83	79	75	72	69	66	63	60	58
	10°	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°

TABLE XXXV.

To correct the Apparent Distance of the Moon from the Sun, a Star, &c. for the Effects of Parallax and Refraction.

Par. in Alt. or Dist.	APPARENT DISTANCE.																				
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1
13	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	1
14	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1
15	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2	2	2	2
16	4	4	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2	2	2	2	2
17	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	2	2	2	2	2	2
18	5	5	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3	2	2	2
19	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	3	3	3	3
20	6	6	5	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3	3	3	3
21	6	6	6	6	5	5	5	5	5	5	4	4	4	4	4	4	4	3	3	3	3
22	7	7	7	6	6	6	6	5	5	5	5	5	5	4	4	4	4	4	4	4	3
23	8	7	7	7	7	6	6	6	6	6	5	5	5	5	5	4	4	4	4	4	4
24	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5	5	5	5	4	4	4
25	9	9	8	8	8	8	7	7	7	6	6	6	6	6	5	5	5	5	5	5	4
26	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6	6	6	5	5	5	5
27	11	10	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6	6	6	5	5
28	11	11	11	10	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6	6	6
29	12	12	11	11	10	10	10	9	9	9	8	8	8	8	7	7	7	7	6	6	6
30	13	13	12	12	11	11	10	10	10	9	9	9	8	8	8	8	7	7	7	7	6
31	14	13	13	12	12	12	11	11	10	10	10	9	9	9	8	8	8	8	7	7	7
32	15	14	14	13	13	12	12	11	11	11	10	10	10	9	9	9	8	8	8	7	7
33	16	15	15	14	14	13	13	12	12	11	11	11	10	10	10	9	9	9	8	8	8
34	17	16	16	15	14	14	13	13	12	12	12	11	11	10	10	10	9	9	9	8	8
35	18	17	16	16	15	15	14	14	13	13	12	12	11	11	11	10	10	10	9	9	9
36	19	18	17	17	16	16	15	14	14	13	13	13	12	12	11	11	11	10	10	9	9
37	20	19	18	18	17	16	16	15	15	14	14	13	13	12	12	12	11	11	10	10	10
38	21	20	19	19	18	17	17	16	16	15	14	14	14	13	13	12	12	11	11	11	10
39	22	21	20	20	19	18	18	17	16	16	15	15	14	14	13	13	12	12	12	11	11
40	23	22	21	21	20	19	19	18	17	17	16	16	15	14	14	13	13	13	12	12	11
41	24	23	23	22	21	20	19	19	18	17	17	16	16	15	15	14	14	13	13	12	12
42	26	25	24	23	22	21	20	20	19	18	18	17	17	16	15	15	14	14	13	13	12
43	27	26	25	24	23	22	21	21	20	19	19	18	17	17	16	16	15	15	14	14	13
44	28	27	26	25	24	23	22	22	21	20	19	19	18	17	17	16	16	15	15	14	14
45	29	28	27	26	25	24	23	23	22	21	20	20	19	18	18	17	16	16	15	15	14
46	31	30	28	27	26	25	25	24	23	22	21	21	20	19	18	18	17	17	16	15	15
47	32	31	30	29	28	27	26	25	24	23	22	21	21	20	19	19	18	17	17	16	16
48	33	32	31	30	29	28	27	26	25	24	23	22	22	21	20	19	19	18	17	17	16
49	35	34	32	31	30	29	28	27	26	25	24	23	22	22	21	20	20	19	18	18	17
50	36	35	34	32	31	30	29	28	27	26	25	24	23	23	22	21	20	20	19	18	18
51	38	36	35	34	32	31	30	29	28	27	26	25	24	24	23	22	21	20	20	19	18
52	39	38	36	35	34	32	31	30	29	28	27	26	25	24	24	23	22	21	21	20	19
53	41	39	38	36	35	34	33	31	30	29	28	27	26	25	25	24	23	22	21	21	20
54	42	41	39	38	36	35	34	33	31	30	29	28	27	26	25	25	24	23	22	21	21
55	44	42	41	39	38	36	35	34	33	31	30	29	28	27	26	25	25	24	23	22	21
56	46	44	42	41	39	38	36	35	34	33	31	30	29	28	27	26	26	25	24	23	22
57	47	45	44	42	40	39	38	36	35	34	33	31	30	29	28	27	26	26	25	24	23
58	49	47	45	44	42	40	39	38	36	35	34	33	31	30	29	28	27	26	26	25	24
59	51	49	47	45	43	42	40	39	38	36	35	34	33	31	30	29	28	27	26	25	25
60	52	50	48	47	45	43	42	40	39	37	36	35	34	33	31	30	29	28	27	26	25
61	54	52	50	48	46	45	43	42	40	39	37	36	35	34	32	31	30	29	28	27	26
62	56	54	52	50	48	46	45	43	41	40	39	37	36	35	34	32	31	30	29	28	27
	31°	32°	33°	34°	35°	36°	37°	38°	39°	40°	41°	42°	43°	44°	45°	46°	47°	48°	49°	50°	51°

TABLE XXXV.

To correct the Apparent Distance of the MOON from the SUN, a STAR, &c. for the Effects of Parallax and Refraction.

Par. in Alt. or Dist.	APPARENT DISTANCE.																				
	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°
M	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″	″
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	20	20	20	20
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	20	20	20	20	20
10	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	20	20	20	20	20	19
11	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	20	20	20	20	20	19
12	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	20	20	20	20	19	19
13	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	20	20	20	19	19	19
14	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	20	20	20	19	19	19
15	2	1	1	1	1	1	1	1	1	1	1	1	0	0	0	20	20	19	19	19	19
16	2	2	2	2	2	1	1	1	1	1	1	1	0	0	0	20	20	19	19	19	19
17	2	2	2	2	2	2	2	2	1	1	1	1	0	0	0	20	20	19	19	19	19
18	2	2	2	2	2	2	2	2	2	1	1	1	0	0	0	20	20	19	19	19	18
19	2	2	2	2	2	2	2	2	2	1	1	1	1	0	0	20	19	19	19	19	18
20	3	3	3	2	2	2	2	2	2	2	1	1	1	0	0	20	19	19	19	18	18
21	3	3	3	3	3	2	2	2	2	2	1	1	1	0	0	20	19	19	19	18	18
22	3	3	3	3	3	3	3	3	2	2	2	1	1	0	0	20	19	19	18	18	18
23	4	3	3	3	3	3	3	3	3	2	2	1	1	0	0	20	19	19	18	18	17
24	4	4	4	4	3	3	3	3	3	2	2	1	1	0	0	20	19	19	18	18	17
25	4	4	4	4	4	4	3	3	3	3	2	1	1	0	0	20	19	19	18	17	17
26	5	4	4	4	4	4	4	4	3	3	2	2	1	1	0	19	19	18	18	17	17
27	5	5	5	4	4	4	4	4	4	3	2	2	1	1	0	19	19	18	18	17	16
28	5	5	5	5	5	4	4	4	4	3	2	2	1	1	0	19	19	18	18	17	16
29	6	6	5	5	5	5	5	4	4	3	3	2	1	1	0	19	19	18	17	17	16
30	6	6	6	5	5	5	5	5	5	4	3	2	1	1	0	19	19	18	17	16	15
31	7	6	6	6	6	5	5	5	5	4	3	2	1	1	0	19	19	18	17	16	15
32	7	7	6	6	6	6	6	5	5	4	3	2	2	1	0	19	18	18	17	16	15
33	7	7	7	7	6	6	6	6	5	4	3	3	2	1	0	19	18	17	17	16	15
34	8	8	7	7	7	7	6	6	6	5	4	3	2	1	0	19	18	17	16	15	14
35	8	8	8	7	7	7	7	6	6	5	4	3	2	1	0	19	18	17	16	15	14
36	9	9	8	8	8	7	7	7	7	5	4	3	2	1	0	19	18	17	16	15	13
37	9	9	9	8	8	8	7	7	7	6	4	3	2	1	0	19	18	17	16	14	13
38	10	9	9	9	8	8	8	8	7	6	5	3	2	1	0	19	18	17	15	14	13
39	10	10	10	9	9	9	8	8	8	6	5	4	2	1	0	19	18	16	15	14	12
40	11	11	10	10	9	9	9	8	8	7	5	4	2	1	0	19	18	16	15	13	12
41	11	11	11	10	10	10	9	9	8	7	5	4	3	1	0	19	17	16	15	13	12
42	12	12	11	11	10	10	10	9	9	7	6	4	3	1	0	19	17	16	14	13	11
43	13	12	12	11	11	10	10	10	9	8	6	4	3	1	0	19	17	16	14	12	11
44	13	13	12	12	11	11	11	10	10	8	6	5	3	1	0	19	17	15	14	12	10
45	14	13	13	12	12	11	11	11	10	8	6	5	3	2	0	18	17	15	14	12	10
46	14	14	13	13	12	12	12	11	11	9	7	5	3	2	0	18	17	15	13	11	9
47	15	15	14	13	13	13	12	12	11	9	7	5	3	2	0	18	17	15	13	11	9
48	16	15	15	14	14	13	13	12	12	9	7	5	4	2	0	18	16	15	13	11	8
49	16	16	15	15	14	14	13	13	12	10	8	6	4	2	0	18	16	14	12	10	8
50	17	16	16	15	15	14	14	13	13	10	8	6	4	2	0	18	16	14	12	10	7
51	18	17	16	16	15	15	14	14	13	11	8	6	4	2	0	18	16	14	12	9	7
52	18	18	17	17	16	15	15	14	14	11	9	6	4	2	0	18	16	14	11	9	6
53	19	18	18	17	17	16	15	15	14	11	9	7	4	2	0	18	16	13	11	9	6
54	20	19	18	18	17	17	16	15	15	12	9	7	4	2	0	18	16	13	11	8	5
55	21	20	19	18	18	17	16	16	15	12	10	7	5	2	0	18	15	13	10	8	5
56	21	21	20	19	18	18	17	16	16	13	10	7	5	2	0	18	15	13	10	7	4
57	22	21	21	20	19	18	18	17	16	13	10	8	5	2	0	18	15	12	10	7	4
58	23	22	21	21	20	19	18	18	17	14	11	8	5	3	0	17	15	12	9	6	3
59	24	23	22	21	20	20	19	18	18	14	11	8	5	3	0	17	15	12	9	6	2
60	25	24	23	22	21	20	20	19	18	15	11	8	6	3	0	17	14	12	9	5	2
61	25	24	24	23	22	21	20	20	19	15	12	9	6	3	0	17	14	11	8	5	1
62	26	25	24	23	23	22	21	20	19	16	12	9	6	3	0	17	14	11	8	4	1
	52°	53°	54°	55°	56°	57°	58°	59°	60°	65°	70°	75°	80°	85°	90°	95°	100°	105°	110°	115°	120°

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	0°			1°			2°			3°			″ Suv.
	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	
0	000000	0	2.000000	000152	0	1.999848	000609	0	1.999391	001370	0	1.998630	60
1	00000	0	00000	00157	0	99843	00619	0	99381	01386	0	98614	59
2	00000	0	00000	00163	0	99837	00630	0	99370	01401	1	98599	58
3	00000	0	00000	00168	0	99832	00640	1	99360	01416	1	98584	57
4	00001	0	1.999999	00173	0	99827	00650	1	99350	01432	1	98568	56
5	00001	0	99999	00179	0	99821	00661	1	99339	01448	1	98552	55
6	00001	0	99999	00184	1	99816	00672	1	99328	01463	2	98537	54
7	00002	0	99998	00190	1	99810	00682	1	99318	01479	2	98521	53
8	00003	1	99997	00196	1	99804	00693	1	99307	01495	2	98505	52
9	00003	1	99997	00201	1	99799	00704	2	99296	01511	2	98489	51
10	00004	1	99996	00207	1	99793	00715	2	99285	01527	3	98473	50
11	000005	1	1.999995	000213	1	1.999787	000726	2	1.999274	001543	3	1.998457	49
12	00006	1	99994	00219	1	99781	00737	2	99263	01559	3	98441	48
13	00007	1	99993	00226	1	99774	00748	2	99252	01575	4	98425	47
14	00008	1	99992	00232	1	99768	00760	3	99240	01592	4	98408	46
15	00009	1	99991	00238	2	99762	00771	3	99229	01608	4	98392	45
16	00011	1	99989	00244	2	99756	00782	3	99218	01625	4	98375	44
17	00012	1	99988	00251	2	99749	00794	3	99206	01641	4	98359	43
18	00014	1	99986	00257	2	99743	00806	3	99194	01658	5	98342	42
19	00015	1	99985	00264	2	99736	00817	4	99183	01675	5	98325	41
20	00017	1	99983	00271	2	99729	00829	4	99171	01692	5	98308	40
21	000019	1	1.999981	000278	2	1.999722	000841	4	1.999159	001709	6	1.998291	39
22	00020	2	99980	00284	2	99716	00853	4	99147	01726	6	98274	38
23	00022	2	99978	00291	2	99709	00865	4	99135	01743	6	98257	37
24	00024	2	99976	00299	3	99701	00877	5	99123	01760	7	98240	36
25	00026	2	99974	00306	3	99694	00889	5	99111	01777	7	98223	35
26	00029	2	99971	00313	3	99687	00902	5	99098	01795	7	98205	34
27	00031	2	99969	00320	3	99680	00914	5	99086	01812	8	98188	33
28	00033	2	99967	00328	3	99672	00927	5	99073	01830	8	98170	32
29	00036	2	99964	00335	3	99665	00939	6	99061	01847	8	98153	31
30	00038	2	99962	00343	3	99657	00952	6	99048	01865	9	98135	30
31	000041	2	1.999959	000350	4	1.999650	000964	7	1.999036	001883	9	1.998117	29
32	00043	2	99957	00358	4	99642	00977	7	99023	01901	10	98099	28
33	00046	2	99954	00366	4	99634	00990	7	99010	01919	10	98081	27
34	00049	2	99951	00374	4	99626	01003	8	98997	01937	11	98063	26
35	00052	2	99948	00382	4	99618	01016	8	98984	01955	11	98045	25
36	00055	2	99945	00390	5	99610	01029	8	98971	01973	11	98027	24
37	00058	2	99942	00398	5	99602	01043	9	98957	01992	12	98008	23
38	00061	2	99939	00406	5	99594	01056	9	98944	02010	12	97990	22
39	00064	2	99936	00415	5	99585	01069	9	98931	02028	12	97972	21
40	00068	2	99932	00423	6	99577	01083	9	98917	02047	13	97953	20
41	000071	2	1.999929	000432	6	1.999568	001096	10	1.998904	002066	13	1.997934	19
42	00075	2	99925	00440	6	99560	01110	10	98890	02084	13	97916	18
43	00078	2	99922	00449	6	99551	01124	10	98876	02103	14	97897	17
44	00082	2	99918	00458	6	99542	01138	10	98862	02122	14	97878	16
45	00086	3	99914	00466	6	99534	01152	11	98848	02141	14	97859	15
46	00089	3	99911	00475	6	99525	01166	11	98834	02160	15	97840	14
47	00093	3	99907	00484	7	99516	01180	11	98820	02179	15	97821	13
48	00097	3	99903	00493	7	99507	01194	11	98806	02198	15	97802	12
49	00102	3	99898	00503	7	99497	01208	11	98792	02218	16	97782	11
50	00106	3	99894	00512	7	99488	01222	12	98778	02237	16	97763	10
51	000110	3	1.999890	000521	7	1.999479	001237	12	1.998763	002257	16	1.997743	9
52	00114	3	99886	00531	7	99469	01251	12	98749	02276	16	97724	8
53	00119	3	99881	00540	7	99460	01266	12	98734	02296	17	97704	7
54	00123	3	99877	00550	8	99450	01281	13	98719	02316	17	97684	6
55	00128	3	99872	00559	8	99441	01295	13	98705	02335	17	97665	5
56	00133	3	99867	00569	8	99431	01310	13	98690	02355	18	97645	4
57	00137	3	99863	00579	8	99421	01325	14	98675	02375	18	97625	3
58	00142	3	99858	00589	8	99411	01340	14	98660	02395	18	97605	2
59	00147	3	99853	00599	8	99401	01355	14	98645	02416	19	97584	1
60	000152	4	1.999848	000609	9	1.999391	001370	14	1.998630	002136	19	1.997561	0
″ Vers.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	′ ″ Suv.
	179°			178°			177°			176°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	4°			5°			6°			7°			″ Suv.
	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	
0	002436	0	1.997561	003805	0	1.996195	005478	0	1.994522	007454	0	1.992546	60
1	02456	0	97541	03831	0	96169	05509	1	94491	07489	1	92511	59
2	02477	1	97523	03856	1	96144	05539	1	94461	07525	1	92475	58
3	02497	1	97503	03882	1	96118	05570	2	94430	07561	2	92439	57
4	02518	1	97482	03907	2	96093	05600	2	94400	07596	2	92404	56
5	02538	2	97462	03933	2	96067	05631	3	94369	07632	3	92368	55
6	02559	2	97441	03959	3	96041	05662	3	94338	07668	4	92332	54
7	02580	3	97420	03985	3	96015	05693	4	94307	07704	4	92296	53
8	02601	3	97399	04011	3	95989	05724	4	94276	07740	5	92260	52
9	02622	3	97378	04037	4	95963	05755	5	94245	07776	6	92224	51
10	02643	4	97357	04063	4	95937	05786	5	94214	07813	6	92187	50
11	002664	4	1.997336	004089	5	1.995911	005818	6	1.994182	007849	7	1.992151	49
12	02685	4	97315	04116	5	95884	05849	6	94151	07885	7	92115	48
13	02707	5	97293	04142	6	95858	05880	7	94120	07922	8	92078	47
14	02728	5	97272	04168	6	95832	05912	7	94088	07958	9	92042	46
15	02750	5	97250	04195	7	95805	05944	8	94056	07995	9	92005	45
16	02771	6	97229	04222	7	95778	05975	8	94025	08032	10	91968	44
17	02793	6	97207	04248	7	95752	06007	9	93993	08069	10	91931	43
18	02815	6	97185	04275	8	95725	06039	9	93961	08106	11	91894	42
19	02837	7	97163	04302	8	95698	06071	10	93929	08143	12	91857	41
20	02859	7	97141	04329	9	95671	06103	10	93897	08180	12	91820	40
21	002881	7	1.997119	004356	9	1.995644	006135	11	1.993865	008217	13	1.991783	39
22	02903	8	97097	04383	10	95617	06167	11	93833	08254	13	91746	38
23	02925	8	97075	04411	10	95589	06200	12	93800	08291	14	91709	37
24	02947	8	97053	04438	11	95562	06232	13	93768	08329	15	91671	36
25	02970	9	97030	04465	11	95535	06264	13	93736	08366	15	91634	35
26	02992	9	97008	04493	11	95507	06297	14	93703	08404	16	91596	34
27	03015	10	96985	04520	12	95480	06330	14	93670	08442	17	91558	33
28	03037	10	96963	04548	12	95452	06362	15	93638	08479	17	91521	32
29	03060	11	96940	04576	13	95424	06395	15	93605	08517	18	91483	31
30	03083	11	96917	04604	14	95396	06428	16	93572	08555	19	91445	30
31	003105	12	1.996895	004632	15	1.995368	006461	17	1.993539	008593	20	1.991407	29
32	03128	13	96872	04660	15	95340	06494	18	93506	08631	21	91369	28
33	03151	13	96849	04688	16	95312	06527	19	93473	08669	22	91331	27
34	03175	14	96825	04716	16	95284	06560	19	93440	08708	22	91292	26
35	03198	14	96802	04744	17	95256	06594	20	93406	08746	23	91254	25
36	03221	15	96779	04773	18	95227	06627	21	93373	08784	24	91216	24
37	03244	15	96756	04801	18	95199	06661	21	93339	08823	24	91177	23
38	03268	16	96732	04829	19	95171	06694	22	93306	08862	25	91138	22
39	03291	16	96709	04858	19	95142	06728	22	93272	08900	26	91100	21
40	03315	16	96685	04887	20	95113	06762	23	93238	08939	26	91061	20
41	003339	17	1.996661	004916	20	1.995084	006795	23	1.993205	008978	27	1.991022	19
42	03363	17	96637	04944	21	95056	06829	24	93171	09017	28	90983	18
43	03386	17	96614	04973	21	95027	06863	24	93137	09056	28	90944	17
44	03410	18	96590	05002	21	94998	06897	25	93103	09095	29	90905	16
45	03434	18	96566	05031	22	94969	06931	26	93069	09134	30	90866	15
46	03459	19	96541	05061	22	94939	06966	26	93034	09173	30	90827	14
47	03483	19	96517	05090	23	94910	07000	27	93000	09213	31	90787	13
48	03507	20	96493	05119	23	94881	07034	28	92966	09252	32	90748	12
49	03531	20	96469	05149	24	94851	07069	28	92931	09292	32	90708	11
50	03556	20	96444	05178	25	94822	07103	29	92896	09331	33	90669	10
51	003580	21	1.996420	005208	25	1.994792	007138	29	1.992862	009371	34	1.990629	9
52	03605	21	96395	05237	26	94763	07173	30	92827	09411	34	90589	8
53	03630	22	96370	05267	26	94733	07208	30	92792	09451	35	90549	7
54	03655	22	96345	05297	27	94703	07243	31	92757	09490	36	90510	6
55	03680	22	96320	05327	27	94673	07278	31	92722	09531	36	90469	5
56	03705	23	96295	05357	28	94643	07313	32	92687	09571	37	90429	4
57	03730	23	96270	05387	28	94613	07348	32	92652	09611	38	90389	3
58	03755	24	96245	05417	29	94583	07383	33	92617	09651	38	90349	2
59	03780	24	96220	05448	29	94552	07418	34	92582	09691	39	90309	1
60	003805	24	1.996195	005478	29	1.994522	007454	34	1.992546	009732	39	1.990268	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	″ ′ Suv.
	175°			174°			173°			172°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′	8°			9°			10°			11°			″
″ Vers.	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Suv.
0	009732	0	1.990268	012312	0	1.987688	015192	0	1.984808	018373	0	1.981627	60
1	09772	1	90228	12357	1	87643	15243	1	84757	18428	1	81572	59
2	09813	1	90187	12403	1	87597	15293	2	84707	18484	2	81516	58
3	09854	2	90146	12449	2	87551	15344	3	84656	18540	3	81460	57
4	09894	3	90106	12494	3	87506	15395	3	84605	18595	4	81405	56
5	09935	3	90065	12540	4	87460	15446	4	84554	18651	5	81349	55
6	09976	4	90024	12586	5	87414	15497	5	84503	18707	6	81293	54
7	10017	5	89983	12632	6	87368	15548	6	84452	18763	7	81237	53
8	10058	6	89942	12678	7	87322	15599	7	84401	18819	7	81181	52
9	10100	6	89900	12725	8	87275	15650	8	84350	18876	8	81124	51
10	10141	7	89859	12771	8	87229	15701	9	84299	18932	9	81068	50
11	010182	8	1.989818	012817	9	1.987183	015753	9	1.984247	018988	10	1.981012	49
12	10224	8	89776	12864	10	87136	15804	10	84196	19045	11	80955	48
13	10265	9	89735	12910	11	87090	15856	11	84144	19101	12	80899	47
14	10307	10	89693	12957	12	87043	15908	12	84092	19158	13	80842	46
15	10349	10	89651	13004	12	86996	15959	13	84041	19215	14	80785	45
16	10390	11	89610	13 50	13	86950	16011	14	83989	19271	15	80729	44
17	10432	12	89568	13097	13	86903	16063	15	83937	19328	16	80672	43
18	10474	12	89526	13144	14	86856	16115	16	83885	19385	17	80615	42
19	10516	13	89484	13191	15	86809	16167	16	83833	19442	18	80558	41
20	10558	14	89442	13238	15	86762	16219	17	83781	19499	19	80501	40
21	010601	14	1.989399	013286	16	1.986714	016271	18	1.983729	019557	20	1.980443	39
22	10643	15	89357	13333	17	86667	16324	19	83676	19614	21	80386	38
23	10685	16	89315	13380	18	86620	16376	20	83624	19671	22	80329	37
24	10728	17	89272	13428	19	86572	16428	21	83572	19729	23	80271	36
25	10770	17	89230	13475	19	86525	16481	22	83519	19786	24	80214	35
26	10813	18	89187	13523	20	86477	16534	22	83466	19844	25	80156	34
27	10855	19	89145	13571	21	86429	16586	23	83414	19902	26	80098	33
28	10898	19	89102	13618	22	86382	16639	24	83361	19959	27	80041	32
29	10941	20	89059	13666	23	86334	16692	25	83308	20017	28	79983	31
30	10984	21	89016	13714	24	86286	16745	26	83255	20075	29	79925	30
31	011027	22	1 988973	013762	25	1.986238	016798	27	1.983202	020133	30	1.979867	29
32	11070	23	88930	13811	26	86189	16851	28	83149	20191	31	79809	28
33	11113	24	88887	13859	27	86141	16904	29	83096	20250	32	79750	27
34	11157	25	88843	13907	28	86093	16958	30	83042	20308	33	79692	26
35	11200	26	88800	13955	29	86045	17011	31	82989	20366	34	79634	25
36	11244	26	88756	14004	30	85996	17065	32	82935	20425	35	79575	24
37	11287	27	88713	14052	31	85948	17118	33	82882	20483	36	79517	23
38	11331	28	88669	14101	32	85899	17172	34	82828	20542	37	79458	22
39	11374	28	88626	14150	33	85850	17226	35	82774	20601	38	79399	21
40	11418	29	88582	14199	33	85801	17279	36	82721	20659	39	79341	20
41	011462	30	1.988538	014248	34	1.985752	017333	37	1.982667	020718	40	1.979282	19
42	11506	31	88494	14296	35	85704	17387	38	82613	20777	41	79223	18
43	11550	32	88450	14346	35	85654	17441	39	82559	20836	42	79164	17
44	11594	32	88406	14395	36	85605	17495	40	82505	20895	43	79105	16
45	11638	33	88362	14444	37	85556	17550	41	82450	20954	44	79046	15
46	11683	34	88317	14493	38	85507	17604	41	82396	21014	45	78986	14
47	11727	35	88273	14543	39	85457	17658	42	82342	21073	46	78927	13
48	11772	35	88228	14592	40	85408	17713	43	82287	21133	47	78867	12
49	11816	36	88184	14642	41	85358	17767	44	82233	21192	48	78808	11
50	11861	37	88139	14691	42	85309	17822	45	82178	21252	49	78748	10
51	011905	38	1.988095	014741	42	1.985259	017877	46	1.982123	021311	50	1.978689	9
52	11950	38	88050	14791	43	85209	17931	47	82069	21371	51	78629	8
53	11995	39	88005	14841	44	85159	17986	48	82014	21431	52	78569	7
54	12040	40	87960	14891	45	85109	18041	49	81959	21491	54	78509	6
55	12085	41	87915	14941	45	85059	18096	50	81904	21551	55	78449	5
56	12130	41	87870	14991	46	85009	18151	50	81849	21611	56	78389	
57	12175	42	87825	15041	47	84959	18207	51	81793	21671	57	78329	3
58	12221	43	87779	15091	48	84909	18262	52	81738	21732	58	78268	2
59	12266	44	87734	15142	49	84858	18317	53	81683	21792	59	78208	1
60	012312	44	1.987688	015192	50	1.984808	018373	54	1.981627	021852	60	1.978148	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	171°			170°			169°			168°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	12°			13°			14°			15°			″ Suv.
	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	
0	021852	0	1.978148	025630	0	1.974370	029704	0	1.970296	034074	0	1.965926	60
1	21913	1	78087	25695	1	74305	29775	1	70225	34149	1	65850	59
2	21973	2	78026	25761	2	74239	29845	2	70155	34225	2	65775	58
3	22031	3	77966	25827	3	74173	29916	3	70084	34300	4	65700	57
4	22095	4	77905	25892	4	74108	29986	5	70014	34376	5	65624	56
5	22156	5	77844	25958	6	74042	30057	6	69943	34452	6	65548	55
6	22217	6	77783	26024	7	73976	30128	7	69872	34527	8	65473	54
7	22278	7	77722	26090	8	73910	30199	8	69801	34603	9	65397	53
8	22339	8	77661	26156	9	73844	30270	9	69730	34679	10	65321	52
9	22400	9	77600	26222	10	73778	30341	10	69659	34755	11	65245	51
10	22461	10	77539	26288	11	73712	30412	12	69588	34831	13	65169	50
11	022523	11	1.977477	026355	13	1.973645	030483	13	1.969517	034907	14	1.965093	49
12	22584	12	77416	26421	14	73579	30555	14	69445	34983	15	65016	48
13	22646	13	77354	26488	15	73512	30626	15	69374	35060	16	64940	47
14	22707	14	77293	26554	16	73446	30697	16	69302	35136	18	64864	46
15	22769	15	77231	26621	17	73379	30769	18	69231	35213	19	64787	45
16	22831	16	77169	26687	18	73313	30841	19	69159	35289	20	64711	44
17	22892	17	77108	26754	19	73246	30912	20	69088	35366	21	64634	43
18	22954	18	77046	26821	20	73179	30984	21	69016	35443	23	64557	42
19	23016	19	76984	26888	21	73112	31056	22	68944	35519	24	64481	41
20	23078	20	76922	26955	22	73045	31128	24	68872	35596	26	64404	40
21	023141	22	1.976859	027022	24	1.972978	031200	25	1.968800	035673	27	1.964327	39
22	23203	23	76797	27089	25	72911	31272	26	68728	35750	28	64250	38
23	23265	24	76735	27157	26	72843	31344	27	68656	35827	29	64173	37
24	23328	25	76672	27224	27	72776	31417	28	68583	35905	31	64095	36
25	23390	26	76610	27292	28	72708	31489	30	68511	35982	32	64018	35
26	23453	27	76547	27359	29	72641	31562	31	68438	36059	33	63941	34
27	23515	28	76485	27427	30	72573	31634	32	68366	36137	34	63863	33
28	23578	29	76422	27494	31	72506	31707	33	68293	36214	36	63786	32
29	23641	30	76359	27562	32	72438	31780	34	68220	36292	37	63708	31
30	23704	31	76296	27630	34	72370	31852	36	68148	36369	38	63631	30
31	023767	32	1.976233	027698	35	1.972302	031925	37	1.968075	036447	40	1.963553	29
32	23830	33	76170	27766	36	72234	31998	38	68002	36525	42	63475	28
33	23893	35	76107	27834	38	72166	32071	40	67929	36603	43	63397	27
34	23956	36	76044	27902	39	72098	32144	41	67856	36681	44	63319	26
35	24020	37	75980	27971	40	72029	32217	43	67783	36759	46	63241	25
36	24083	38	75917	28039	41	71961	32291	44	67709	36837	47	63163	24
37	24147	39	75853	28107	42	71893	32364	45	67636	36916	48	63084	23
38	24210	40	75790	28176	44	71824	32438	47	67562	36994	49	63006	22
39	24274	41	75726	28245	45	71755	32511	48	67489	37072	51	62928	21
40	24338	42	75662	28313	46	71687	32585	49	67415	37151	52	62849	20
41	024401	43	1.975599	028382	47	1.971618	032658	50	1.967342	037230	53	1.962770	19
42	24465	44	75535	28451	48	71549	32732	52	67268	37308	55	62692	18
43	24529	45	75471	28520	49	71480	32806	53	67194	37387	56	62613	17
44	24593	46	75407	28589	50	71411	32880	54	67120	37466	57	62534	16
45	24658	47	75342	28658	52	71342	32954	55	67046	37545	59	62455	15
46	24722	49	75278	28727	53	71273	33028	57	66972	37624	60	62376	14
47	24786	50	75214	28796	54	71204	33102	58	66898	37703	61	62297	13
48	24851	51	75149	28866	55	71134	33177	59	66823	37782	63	62218	12
49	24915	52	75085	28935	56	71065	33251	60	66749	37861	64	62139	11
50	24980	53	75020	29005	57	70995	33325	62	66675	37941	65	62059	10
51	025044	54	1.974956	029074	59	1.970926	033400	63	1.966600	038020	67	1.961980	9
52	25109	55	74891	29144	60	70856	33474	64	66526	38099	68	61901	8
53	25174	56	74826	29214	61	70786	33549	65	66451	38179	69	61821	7
54	25239	57	74761	29283	62	70717	33624	66	66376	38259	71	61741	6
55	25304	58	74696	29353	63	70647	33699	68	66301	38338	72	61662	5
56	25369	59	74631	29423	64	70577	33774	69	66226	38418	73	61582	4
57	25434	60	74566	29493	66	70507	33849	70	66151	38498	75	61502	3
58	25499	61	74501	29564	67	70436	33924	72	66076	38578	76	61422	2
59	25564	62	74436	29634	68	70366	33999	73	66001	38658	78	61342	1
60	025630	64	1.974370	029704	69	1.970296	034074	74	1.965926	038738	79	1.961262	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Sur.
	167°			166°			165°			164°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

'	16°			17°			18°			19°			
" Vers.	Versed	Parts for "	*Suvers.*	Versed	Parts for "	*Suvers.*	Versed	Parts for "	*Suvers.*	Versed	Parts for "	*Suvers.*	" Suv.
0	038738	0	1.961262	043695	0	1.956305	048943	0	1.951057	054481	0	1.945519	60
1	38818	1	61182	43780	1	56220	49033	2	59967	54576	2	45424	59
2	38899	3	61101	43865	3	56135	49123	3	50877	54671	3	45329	58
3	38979	4	61021	43951	4	56049	49213	5	50787	54766	5	45234	57
4	39060	5	60940	44036	6	55964	49304	6	50696	54861	6	45139	56
5	39140	7	60860	44121	7	55879	49394	8	50606	54956	8	45044	55
6	39221	8	60779	44207	9	55793	49484	9	50516	55051	10	44949	54
7	39302	9	60698	44293	10	55707	49575	11	50425	55146	11	44854	53
8	39382	11	60618	44378	11	55622	49665	12	50335	55242	13	44758	52
9	39463	12	60537	44464	13	55536	49756	14	50244	55337	14	44663	51
10	39544	14	60456	44550	14	55450	49846	15	50154	55432	16	44568	50
11	039625	15	1.960375	044636	16	1.955364	049937	17	1.950063	055528	18	1.944472	49
12	39706	16	60294	44722	17	55278	50028	18	49972	55624	19	44376	48
13	39787	18	60213	44808	19	55192	50119	20	49881	55719	21	44281	47
14	39869	19	60131	44894	20	55106	50210	21	49790	55815	22	44185	46
15	39950	20	60050	44980	22	55020	50301	23	49699	55911	24	44089	45
16	40032	22	59968	45066	23	54934	50392	24	49608	56007	26	43993	44
17	40113	23	59887	45153	24	54847	50483	26	49517	56103	27	43897	43
18	40195	24	59805	45239	26	54761	50574	27	49426	56199	29	43801	42
19	40276	26	59724	45326	27	54674	50666	29	49334	56295	30	43705	41
20	40358	27	59642	45412	29	54588	50757	30	49243	56391	32	43609	40
21	040440	28	1.959560	045 .99	30	1.954501	050849	32	1.949151	056488	34	1.943512	39
22	40522	30	59478	45586	32	54414	50940	33	49060	56584	35	43416	38
23	40604	31	59396	45673	33	54327	51032	35	48968	56681	37	43319	37
24	40686	32	59314	45760	35	54240	51124	36	48876	56777	38	43223	36
25	40768	34	59232	45847	36	54153	51216	38	48784	56874	40	43126	35
26	40850	35	59150	45934	37	54066	51308	39	48692	56971	42	43029	34
27	40933	36	59067	46021	39	53979	51400	41	48600	57068	43	42932	33
28	41015	38	58985	46108	40	53892	51492	42	48508	57164	45	42836	32
29	41098	39	58902	46196	42	53804	51584	44	48416	57261	47	42739	31
30	41180	41	58820	46283	44	53717	51676	46	48324	57358	48	42642	39
31	041263	43	1.958737	046371	45	1.953629	051769	48	1.948231	057456	51	1.942544	29
32	41346	44	58654	46458	47	53542	51861	50	48139	57553	52	42447	28
33	41428	46	58572	46546	48	53454	51954	51	48046	57650	54	42350	27
34	41511	47	58489	46634	50	53366	52046	53	47954	57747	56	42253	26
35	41594	49	58406	46721	51	53279	52139	54	47861	57845	57	42155	25
36	41677	50	58323	46809	53	53191	52232	56	47768	57942	59	42058	24
37	41761	51	58239	46897	55	53103	52324	57	47676	58040	60	41960	23
38	41844	53	58156	46985	56	53015	52417	59	47583	58138	62	41862	22
39	41927	54	58073	47074	58	52926	52510	61	47490	58236	64	41764	21
40	42010	55	57990	47162	59	52838	52603	62	47397	58333	66	41667	20
41	042094	57	1.957906	047250	61	1.952750	052696	64	1.947304	058431	67	1.941569	19
42	42177	58	57823	47338	62	52662	52790	65	47210	58529	69	41471	18
43	42261	59	57739	47427	64	52573	52883	67	47117	58628	71	41372	17
44	42345	61	57655	47516	65	52484	52976	68	47024	58726	72	41274	16
45	42429	62	57571	47604	67	52396	53070	70	46930	58824	74	41176	15
46	42512	64	57488	47693	68	52307	53163	71	46837	58922	75	41078	14
47	42596	65	57404	47782	70	52218	53257	73	46743	59021	77	40979	13
48	42680	66	57320	47871	71	52129	53351	75	46649	59119	79	40881	12
49	42765	68	57235	47960	73	52040	53444	76	46556	59218	80	40782	11
50	42849	69	57151	48049	74	51951	53538	78	46462	59316	82	40684	10
51	042933	71	1.957067	048138	76	1.951862	053632	79	1.946368	059415	84	1.940585	9
52	43017	72	56983	48227	77	51773	53726	81	46274	59514	85	40486	8
53	43102	74	56898	48316	79	51684	53820	82	46180	59613	87	40387	7
54	43186	75	56814	48406	80	51594	53915	84	46085	59712	89	40288	6
55	43271	77	56729	48495	82	51505	54009	85	45991	59811	90	40189	5
56	43356	78	56644	48585	83	51415	54103	87	45897	59910	92	40090	4
57	43440	80	56560	48674	85	51326	54198	88	45802	60009	94	39991	3
58	43525	81	56475	48764	86	51236	54292	90	45708	60109	95	39891	2
59	43610	82	56390	48854	88	51146	54387	92	45613	60208	97	39792	1
60	043695	83	1.956395	048943	89	1.951057	054481	93	1.945519	060307	98	1.939693	0
" Vers.	*Suvers.*	Parts for "	Versed	*Suvers.*	Parts for "	Versed	*Suvers.*	Parts for "	Versed	*Suvers.*	Parts for "	Versed	' " Suv.
	163°			162°			161°			160°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers	20°			21°			22°			23°			″ Suv.
	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	
0	060307	0	1.939693	066420	0	1.933580	072816	0	1.927184	079495	0	1.920505	60
1	69407	2	39593	66521	2	33476	72925	2	27075	79609	2	20391	59
2	60506	3	39494	66628	4	33372	73034	4	26966	79723	4	20277	58
3	60606	5	39394	66733	5	33267	73143	5	26857	79836	6	20164	57
4	60706	7	39294	66837	7	33163	73253	7	26747	79950	8	20050	56
5	69806	8	39194	66942	9	33058	73362	9	26638	80064	10	19936	55
6	60906	10	39094	67046	11	32954	73471	11	26529	80178	11	19822	54
7	61006	12	38994	67151	12	32849	73581	13	26419	80293	13	19707	53
8	61106	13	38894	67256	14	32744	73690	15	26310	80407	15	19593	52
9	61206	15	38794	67361	16	32639	73800	17	26200	80521	17	19479	51
10	61306	17	38694	67466	18	32534	73910	18	26090	80636	19	19364	50
11	061407	18	1.938593	067571	19	1.932429	074019	20	1.925981	080750	21	1.919250	49
12	61507	20	38493	67676	21	32324	74129	22	25871	80865	23	19135	48
13	61607	22	38393	67781	23	32219	74239	24	25761	80979	25	19021	47
14	61708	23	38292	67887	25	32113	74349	26	25651	81094	27	18906	46
15	61809	25	38191	67992	26	32008	74459	28	25541	81209	29	18791	45
16	61909	27	38091	68098	28	31902	74570	29	25430	81324	31	18676	44
17	62010	28	37990	68203	30	31797	74680	31	25320	81439	33	18561	43
18	62111	30	37889	68309	32	31691	74790	33	25210	81554	35	18446	42
19	62212	32	37788	68414	33	31586	74901	35	25099	81669	37	18331	41
20	62313	34	37687	68520	35	31480	75011	37	24989	81784	38	18216	40
21	062414	35	1.937586	068626	37	1.931374	075122	39	1.924878	081899	40	1.918101	39
22	62515	37	37485	68732	39	31268	75232	40	24768	82014	42	17986	38
23	62617	39	37383	68838	40	31162	75343	42	24657	82130	44	17870	37
24	62718	40	37282	68944	42	31056	75454	44	24546	82245	46	17755	36
25	62819	42	37181	69050	44	30950	75565	46	24435	82361	48	17639	35
26	62921	44	37079	69157	46	30843	75676	48	24324	82477	50	17523	34
27	63023	46	36977	69263	48	30737	75787	50	24213	82592	52	17408	33
28	63124	47	36876	69369	50	30631	75898	52	24102	82708	54	17292	32
29	63226	49	36774	69476	52	39524	76009	54	23991	82824	56	17176	31
30	63328	51	36672	69582	53	30418	76120	56	23880	82940	58	17060	30
31	063430	53	1.936570	069689	55	1.930311	076232	58	1.923768	083056	60	1.916944	29
32	63532	55	36468	69796	57	30204	76343	60	23657	83172	62	16828	28
33	63634	57	36366	69903	59	30097	76455	62	23545	83288	64	16712	27
34	63736	58	36264	70009	61	29991	76566	64	23434	83404	66	16596	26
35	63838	60	36162	70116	63	29884	76678	65	23322	83521	68	16479	25
36	63940	62	36060	70223	65	29777	76790	67	23210	83637	70	16363	24
37	64043	63	35957	70331	67	29669	76902	69	23098	83754	72	16246	23
38	64145	65	35855	70438	69	29562	77013	71	22987	83870	74	16130	22
39	64248	67	35752	70545	71	29455	77125	73	22875	83987	76	16013	21
40	64350	69	35650	70652	72	29348	77238	75	22762	84104	78	15896	20
41	064453	70	1.935547	070760	74	1.929240	077350	77	1.922650	084220	80	1.915780	19
42	64556	72	35444	70867	76	29133	77462	79	22538	84337	82	15663	18
43	64659	74	35341	70975	78	29025	77574	81	22426	84454	84	15546	17
44	64762	75	35238	71083	80	28917	77687	83	22313	84571	86	15429	16
45	64865	77	35135	71190	81	28810	77799	84	22201	84688	88	15312	15
46	64968	79	35032	71298	83	28702	77912	86	22088	84806	90	15194	14
47	65071	81	34929	71406	85	28594	78024	88	21976	84923	92	15077	13
48	65174	82	34826	71514	87	28486	78137	90	21863	85040	94	14960	12
49	65278	84	34722	71622	89	28378	78250	92	21750	85158	96	14842	11
50	65381	86	34619	71730	90	28270	78362	94	21638	85275	98	14725	10
51	065485	87	1.934515	071839	92	1.928161	078475	96	1.921525	085393	100	1.914607	9
52	65588	89	34412	71947	94	28053	78588	98	21412	85510	102	14490	8
53	65692	91	34308	72055	96	27945	78701	100	21299	85628	104	14372	7
54	65795	93	34205	72164	98	27836	78815	101	21185	85746	106	14254	6
55	65899	95	34101	72272	100	27728	78928	103	21072	85864	108	14136	5
56	66093	96	33997	72381	101	27619	79041	105	20959	85982	110	14018	4
57	66107	98	33893	72490	103	27510	79154	107	20846	86100	112	13900	3
58	66211	100	33789	72598	105	27402	79268	109	20732	86218	114	13782	2
59	66315	101	33685	72707	107	27293	79381	110	20619	86336	116	13664	1
60	066420	103	1.933580	072816	109	1.927184	079495	112	1.920505	086454	118	1.913546	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	159°			158°			157°			156°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	24°			25°			26°			27°			″ Suv.
	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	
0	086454	0	1.913546	093692	0	1.906308	101206	0	1.898794	108993	0	1.891007	60
1	86573	2	13427	93815	2	06185	01333	2	98667	09126	2	90874	59
2	86691	4	13309	93938	4	06062	01461	4	98539	09258	4	90742	58
3	86810	6	13190	94061	6	05939	01589	6	98411	09390	6	90610	57
4	86928	8	13072	94185	8	05815	01717	8	98283	09522	8	90478	56
5	87047	10	12953	94308	10	05692	01844	11	98156	09655	11	90345	55
6	87166	12	12834	94431	12	05569	01972	13	98028	09787	13	90213	54
7	87285	14	12715	94555	14	05445	02100	15	97900	09920	15	90080	53
8	87403	16	12597	94678	16	05322	02228	17	97772	10052	17	89948	52
9	87522	18	12478	94802	18	05198	02357	19	97643	10185	19	89815	51
10	87642	20	12358	94925	21	05075	02485	21	97515	10318	21	89682	50
11	087761	22	1.912239	095049	23	1.904951	102613	23	1.897387	110451	23	1.889549	49
12	87880	24	12120	95173	25	04827	02742	26	97258	10584	26	89416	48
13	87999	26	12001	95297	27	04703	02870	28	97130	10717	28	89283	47
14	88118	28	11882	95421	29	04579	02999	30	97001	10850	30	89150	46
15	88238	30	11762	95545	31	04455	03127	32	96873	10983	32	89017	45
16	88357	32	11643	95669	33	04331	03256	34	96744	11116	35	88884	44
17	88477	34	11523	95793	35	04207	03385	36	96615	11249	37	88751	43
18	88597	36	11403	95917	37	04083	03514	38	96486	11383	39	88617	42
19	88716	38	11284	96042	39	03958	03642	40	96358	11516	41	88484	41
20	88836	40	11164	96166	41	03834	03771	43	96229	11650	44	88350	40
21	088956	42	1.911044	096291	43	1.903709	103901	45	1.896099	111783	46	1.888217	39
22	89076	44	10924	96415	45	03585	04030	47	95970	11917	48	88083	38
23	89196	46	10804	96540	47	03460	04159	49	95841	12051	50	87949	37
24	89316	48	10684	96665	49	03335	04288	52	95712	12185	52	87815	36
25	89436	50	10564	96789	51	03211	04418	54	95582	12318	55	87682	35
26	89557	52	10443	96914	54	03086	04547	57	95453	12452	58	87548	34
27	89677	54	10323	97039	56	02961	04677	58	95323	12587	60	87413	33
28	89798	56	10202	97164	58	02836	04806	60	95194	12721	62	87279	32
29	89918	58	10082	97289	60	02711	04936	62	95064	12855	64	87145	31
30	90039	60	09961	97415	63	02585	05066	65	94934	12989	67	87011	30
31	090159	62	1.909841	097540	65	1.902460	105195	67	1.894805	113123	69	1.886877	29
32	90280	64	09720	97665	67	02335	05325	69	94675	13258	71	86742	28
33	90401	66	09599	97791	69	02209	05455	71	94545	13392	74	86608	27
34	90522	68	09478	97916	71	02084	05585	73	94415	13527	76	86473	26
35	90643	70	09357	98042	73	01958	05716	75	94284	13662	78	86338	25
36	90764	72	09236	98167	75	01833	05846	78	94154	13796	81	86204	24
37	90885	74	09115	98293	77	01707	05976	80	94024	13931	83	86069	23
38	91006	76	08994	98419	79	01581	06106	82	93894	14066	85	85934	22
39	91127	78	08873	98545	81	01455	06237	84	93763	14201	87	85799	21
40	91249	80	08751	98671	84	01329	06367	86	93633	14336	90	85664	20
41	091370	82	1.908630	098797	86	1.901203	106498	89	1.893502	114471	92	1.885529	19
42	91492	84	08508	98923	88	01077	06629	91	93371	14606	94	85394	18
43	91613	86	08387	99049	90	00951	06759	93	93241	14742	96	85258	17
44	91735	88	08265	99175	92	00825	06890	95	93110	14877	98	85123	16
45	91857	90	08143	99302	95	00698	07021	97	92979	15012	101	84988	15
46	91979	92	08021	99428	97	00572	07152	100	92848	15148	103	84852	14
47	92100	94	07900	99555	99	00445	07283	102	92717	15283	105	84717	13
48	92222	96	07778	99681	101	00319	07414	104	92586	15419	107	84581	12
49	92345	98	07655	99808	103	00192	07545	106	92455	15555	110	84445	11
50	92467	100	07533	099935	105	1.900065	07677	108	92323	15690	112	84310	10
51	092589	102	1.907411	100061	107	1.899939	107808	111	1.892192	115826	114	1.884174	9
52	92711	104	07289	00188	109	99812	07939	113	92061	15962	116	84038	8
53	92833	106	07167	00315	111	99685	08071	115	91929	16098	119	83902	7
54	92956	109	07044	00442	113	99558	08202	117	91798	16234	121	83766	6
55	93078	111	06922	00569	116	99431	08334	119	91666	16370	124	83630	5
56	93201	113	06799	00696	118	99304	08466	122	91534	16507	126	83493	4
57	93324	115	06676	00824	120	99176	08598	124	91402	16643	129	83357	3
58	93446	117	06554	00951	122	99049	08729	126	91271	16779	131	83221	2
59	93569	119	06431	01078	124	98922	08861	129	91139	16916	133	83084	1
60	093692	121	1.906308	101206	127	1.898794	108993	131	1.891007	117052	136	1.882948	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	155°			154°			153°			152°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	28°			29°			30°			31°			″ Suv.
	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	
0	117052	0	1.882948	125380	0	1.874620	133975	0	1.866025	142833	0	1.857167	60
1	17189	2	82811	25521	2	74479	34120	2	65880	42983	3	57017	59
2	17326	4	82674	25662	5	74338	34266	5	65734	43132	5	56868	58
3	17462	6	82538	25804	7	74196	34411	7	65589	43282	8	56718	57
4	17599	9	82401	25945	9	74055	34557	9	65443	43433	10	56567	56
5	17736	11	82264	26086	12	73914	34703	12	65297	43583	13	56417	55
6	17873	13	82127	26228	14	73772	34849	15	65151	43733	15	56267	54
7	18010	16	81990	26369	16	73631	34994	17	65006	43883	17	56117	53
8	18147	18	81853	26511	19	73489	35140	19	64860	44034	20	55966	52
9	18284	21	81716	26652	21	73348	35287	22	64713	44184	22	55816	51
10	18422	23	81578	26794	24	73206	35433	24	64567	44334	25	55666	50
11	118559	25	1.881441	126936	26	1.873064	135579	27	1.864421	144485	27	1.855515	49
12	18696	27	81304	27078	29	72922	35725	29	64275	44636	30	55364	48
13	18834	30	81166	27220	31	72780	35872	32	64128	44786	32	55214	47
14	18972	32	81028	27362	33	72638	36018	34	63982	44937	35	55063	46
15	19109	34	80891	27504	36	72496	36164	37	63836	45088	38	54912	45
16	19247	37	80753	27646	38	72354	36311	39	63689	45239	40	54761	44
17	19385	39	80615	27788	40	72212	36458	41	63542	45390	43	54610	43
18	19523	41	80477	27931	43	72069	36604	44	63396	45541	45	54459	42
19	19661	43	80339	28073	45	71927	36751	46	63249	45692	47	54308	41
20	19799	46	80201	28216	47	71784	36898	49	63102	45844	50	54156	40
21	119937	48	1.880063	128358	49	1.871642	137045	51	1.862955	145995	52	1.854005	39
22	20075	52	79925	28501	52	71499	37192	54	62808	46146	55	53854	38
23	20213	54	79787	28643	54	71357	37339	56	62661	46298	57	53702	37
24	20351	56	79649	28786	56	71214	37486	59	62514	46449	60	53551	36
25	20490	58	79510	28929	59	71071	37634	61	62366	46601	62	53399	35
26	20628	60	79372	29072	61	70928	37781	63	62219	46752	65	53248	34
27	20767	62	79233	29215	64	70785	37928	66	62072	46904	67	53096	33
28	20905	64	79095	29358	66	70642	38076	68	61924	47056	70	52944	32
29	21044	67	78956	29501	69	70499	38223	71	61777	47208	73	52792	31
30	21183	69	78817	29644	71	70356	38371	74	61629	47360	76	52640	30
31	121322	71	1.878678	129788	74	1.870212	138518	77	1.861482	147512	78	1.852488	29
32	21461	73	78539	29931	77	70069	38666	80	61334	47664	81	52336	28
33	21600	76	78400	30074	79	69926	38814	82	61186	47816	83	52184	27
34	21739	78	78261	30218	82	69782	38962	84	61038	47968	85	52032	26
35	21878	81	78122	30361	84	69639	39110	87	60890	48121	88	51879	25
36	22017	84	77983	30505	87	69495	39258	89	60742	48273	90	51727	24
37	22156	86	77844	30649	89	69351	39406	92	60594	48425	93	51575	23
38	22296	89	77704	30793	91	69207	39554	94	60446	48578	96	51422	22
39	22435	91	77565	30936	94	69064	39702	97	60298	48731	99	51269	21
40	22575	93	77425	31080	96	68920	39851	99	60149	48883	102	51117	20
41	122714	95	1.877286	131224	98	1.868776	139999	102	1.860001	149036	105	1.850964	19
42	22854	97	77146	31368	101	68632	40148	103	59852	49189	107	50811	18
43	22994	100	77006	31513	103	68487	40296	106	59704	49342	109	50658	17
44	23133	102	76867	31657	105	68343	40445	109	59555	49495	111	50505	16
45	23273	105	76727	31801	108	68199	40594	112	59406	49648	114	50352	15
46	23413	107	76587	31946	110	68054	40742	114	59258	49801	117	50199	14
47	23553	109	76447	32090	112	67910	40891	116	59109	49954	119	50046	13
48	23693	112	76307	32234	115	67766	41040	118	58960	50107	122	49893	12
49	23833	114	76167	32379	117	67621	41189	121	58811	50261	125	49739	11
50	23974	117	76026	32524	119	67476	41338	124	58662	50414	128	49586	10
51	124114	119	1.875886	132669	122	1.867331	141487	126	1.858513	150567	131	1.849433	9
52	24254	122	75746	32813	124	67187	41636	129	58364	50721	133	49279	8
53	24395	124	75605	32958	127	67042	41786	131	58214	50875	135	49125	7
54	24535	126	75465	33103	129	66897	41935	134	58065	51028	138	48972	6
55	24676	129	75324	33248	132	66752	42084	136	57916	51182	140	48818	5
56	24817	131	75183	33393	134	66607	42234	139	57766	51336	143	48664	4
57	24958	133	75042	33539	137	66461	42384	142	57616	51490	145	48510	3
58	25098	136	74902	33684	139	66316	42533	145	57467	51644	148	48356	2
59	25239	138	74761	33829	142	66171	42683	147	57317	51798	151	48202	1
60	125380	140	1.874620	133975	144	1.866025	142833	149	1.857167	151952	153	1.848048	0
″ Vers.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	′ ″ Suv.
	151°			150°			149°			148°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	32°			33°			34°			35°			″ Suv
	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	
0	151952	0	1.848045	161329	0	1.838671	170962	0	1.829038	180848	0	1.819152	60
1	52106	3	47894	61488	3	38512	71125	3	28875	81015	3	18985	59
2	52260	5	47740	61646	5	38354	71288	6	28712	81182	6	18818	58
3	52415	8	47585	61805	8	38195	71451	8	28549	81349	9	18651	57
4	52569	10	47431	61964	11	38036	71614	11	28386	81516	11	18484	56
5	52723	13	47277	62122	13	37878	71777	14	28223	81683	14	18317	55
6	52878	16	47122	62281	16	37719	71940	16	28060	81850	17	18150	54
7	53033	18	46967	62440	19	37560	72103	19	27897	82018	20	17982	53
8	53187	20	46813	62599	22	37401	72266	22	27734	82185	23	17815	52
9	53342	23	46658	62758	24	37242	72429	25	27571	82352	25	17648	51
10	53497	26	46503	62917	27	37083	72593	27	27407	82520	28	17480	50
11	153652	28	1.846348	163076	29	1.836924	172756	30	1.827244	182687	31	1.817313	49
12	53807	31	46193	63236	32	36764	72919	33	27081	82855	34	17145	48
13	53962	33	46038	63395	35	36605	73083	36	26917	83023	36	16977	47
14	54117	36	45883	63554	38	36446	73247	38	26753	83191	39	16809	46
15	54272	39	45728	63714	40	36286	73410	41	26590	83358	42	16642	45
16	54427	41	45573	63873	43	36127	73574	44	26426	83526	44	16474	44
17	54583	44	45417	64033	46	35967	73738	47	26262	83694	47	16306	43
18	54738	47	45262	64193	48	35807	73902	49	26098	83862	50	16138	42
19	54894	49	45106	64352	51	35648	74066	52	25934	84030	53	15970	41
20	55049	52	44951	64512	54	35488	74230	55	25770	84199	56	15801	40
21	155205	54	1.844795	164672	56	1.835328	174394	57	1.825606	184367	58	1.815633	39
22	55360	57	44640	64832	59	35168	74558	60	25442	84535	61	15465	38
23	55516	60	44484	64992	62	35008	74722	63	25278	84704	64	15296	37
24	55672	62	44328	65152	65	34848	74887	65	25113	84872	67	15128	36
25	55828	65	44172	65312	67	34688	75051	68	24949	85041	70	14959	35
26	55984	68	44016	65473	70	34527	75215	71	24785	85209	73	14791	34
27	56140	72	43860	65633	72	34367	75380	73	24620	85378	76	14622	33
28	56296	74	43704	65793	75	34207	75544	76	24456	85547	79	14453	32
29	56452	76	43548	65954	78	34046	75709	79	24291	85716	82	14284	31
30	56609	78	43391	66114	81	33886	75874	82	24126	85884	84	14116	30
31	156765	81	1.843235	166275	84	1.833725	176039	84	1.823961	186053	87	1.813947	29
32	56921	84	43079	66435	87	33565	76203	87	23797	86222	90	13778	28
33	57078	87	42922	66596	90	33404	76368	90	23632	86392	93	13608	27
34	57234	90	42766	66757	93	33243	76533	93	23467	86561	95	13439	26
35	57391	92	42609	66918	95	33082	76698	96	23302	86730	98	13270	25
36	57548	94	42452	67079	98	32921	76864	99	23136	86899	101	13101	24
37	57704	97	42296	67240	101	32760	77029	102	22971	87069	104	12931	23
38	57861	99	42139	67401	103	32599	77194	105	22806	87238	107	12762	22
39	58018	102	41982	67562	106	32438	77359	108	22641	87408	110	12592	21
40	58175	105	41825	67723	108	32277	77525	111	22475	87577	113	12423	20
41	158332	108	1.841668	167885	111	1.832115	177690	114	1.822310	187747	115	1.812253	19
42	58489	111	41511	68046	114	31954	77856	116	22144	87916	118	12084	18
43	58646	113	41354	68207	116	31793	78022	119	21978	88086	121	11914	17
44	58804	115	41196	68369	119	31631	78187	122	21813	88256	124	11744	16
45	58961	118	41039	68530	121	31470	78353	125	21647	88426	127	11574	15
46	59118	121	40882	68692	124	31308	78519	128	21481	88596	130	11404	14
47	59276	123	40724	68854	127	31146	78685	131	21315	88766	133	11234	13
48	59433	126	40567	69016	129	30984	78851	134	21149	88936	136	11064	12
49	59591	128	40409	69177	132	30823	79017	136	20983	89106	139	10894	11
50	59749	131	40251	69339	135	30661	79183	139	20817	89277	142	10723	10
51	159906	134	1.840094	169501	138	1.830499	179349	142	1.820651	189447	144	1.810553	9
52	60061	136	39936	69663	141	30337	79515	145	20485	89617	147	10383	8
53	60222	139	39778	69826	143	30174	79682	147	20318	89788	150	10212	7
54	60380	142	39620	69988	146	30012	79848	150	20152	89958	153	10042	6
55	60538	144	39462	70150	148	29850	80015	153	19985	90129	156	09871	5
56	60696	147	39304	70312	151	29688	80181	156	19819	90300	159	09700	4
57	60854	150	39146	70475	154	29525	80348	158	19652	90470	162	09530	3
58	61013	152	38987	70637	156	29363	80514	161	19486	90641	164	09359	2
59	61171	155	38829	70800	159	29200	80681	164	19319	90812	167	09188	1
60	161329	157	1.838671	170962	162	1.829038	180848	166	1.819152	190983	170	1.809017	0
″ Vers.	*Suvers.*	Parts for ′	Versed	*Suvers.*	Parts for ″	Versed	*Suvers.*	Parts for ″	Versed	*Suvers.*	Parts for ″	Versed	′ ″ Suv.
	147°			146°			145°			144°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers	36°			37°			38°			39°			″ Suv.
	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	
0	190983	0	1.809017	201364	0	1.798636	211989	0	1.788011	222854	0	1.777146	60
1	91154	3	08846	01540	3	98460	12168	3	87832	23037	3	76963	59
2	91325	6	08675	01715	6	98285	12348	6	87652	23220	6	76780	58
3	91496	9	08504	01890	9	98110	12527	9	87473	23404	9	76596	57
4	91667	11	08333	02065	12	97935	12706	12	87294	23587	12	76413	56
5	91839	14	08161	02241	15	97759	12886	15	87114	23770	15	76230	55
6	92010	17	07990	02416	18	97584	13065	18	86935	23954	18	76046	54
7	92181	20	07819	02592	20	97408	13244	21	86756	24137	21	75863	53
8	92353	23	07647	02767	23	97233	13424	24	86576	24321	24	75679	52
9	92525	26	07475	02943	26	97057	13604	27	86396	24504	27	75496	51
10	92696	29	07304	03118	29	96882	13783	30	86217	24688	31	75312	50
11	192868	32	1.807132	203294	32	1.796706	213963	33	1.786037	224872	34	1.775128	49
12	93040	34	06960	03470	35	96530	14143	36	85857	25056	37	74945	48
13	93211	37	06789	03646	38	96354	14323	39	85677	25239	40	74761	47
14	93383	40	06617	03822	41	96178	14503	42	85497	25423	43	74577	46
15	93555	43	06445	03998	44	96002	14683	45	85317	25607	46	74393	45
16	93727	46	06273	04174	47	95826	14863	48	85137	25791	49	74209	44
17	93899	49	06101	04350	50	95650	15043	51	84957	25976	52	74024	43
18	94072	52	05928	04527	53	95473	15224	54	84776	26160	55	73840	42
19	94244	55	05756	04703	56	95297	15404	57	84596	26344	58	73656	41
20	94416	57	05584	04879	59	95121	15584	60	84416	26528	61	73472	40
21	194589	60	1.805411	205056	62	1.794944	215765	63	1.784235	226713	65	1.773287	39
22	94761	63	05239	05232	65	94768	15945	66	84055	26897	68	73103	38
23	94934	66	05066	05409	68	94591	16126	69	83874	27082	71	72918	37
24	95106	69	04894	05585	71	94415	16306	72	83694	27266	74	72734	36
25	95279	72	04721	05762	74	94238	16487	75	83513	27451	77	72549	35
26	95452	75	04548	05939	76	94061	16668	78	83332	27636	80	72364	34
27	95624	78	04376	06116	79	93884	16849	81	83151	27821	83	72179	33
28	95797	81	04203	06293	82	93707	17030	84	82970	28005	86	71995	32
29	95970	84	04030	06470	85	93530	17211	87	82789	28190	89	71810	31
30	96143	86	03857	06647	88	93353	17392	90	82608	28375	92	71625	30
31	196316	89	1.803684	206824	92	1.793176	217573	94	1.782427	228560	97	1.771440	29
32	96489	92	03511	07001	95	92999	17754	97	82246	28746	100	71254	28
33	96662	95	03338	07178	98	92822	17935	100	82065	28931	103	71069	27
34	96836	98	03164	07356	101	92644	18117	103	81883	29116	106	70884	26
35	97009	101	02991	07533	104	92467	18298	106	81702	29301	109	70699	25
36	97182	104	02818	07710	107	92290	18480	109	81520	29487	112	70513	24
37	97356	107	02644	07888	110	92112	18661	112	81339	29672	115	70328	23
38	97529	110	02471	08065	113	91935	18843	115	81157	29858	118	70142	22
39	97703	113	02297	08243	116	91757	19024	118	80976	30043	121	69957	21
40	97877	116	02123	08421	119	91579	19206	121	80794	30229	124	69771	20
41	198050	118	1.801950	208599	121	1.791401	219388	125	1.780612	230415	127	1.769585	19
42	98224	121	01776	08776	124	91224	19570	128	80430	30600	130	69400	18
43	98398	124	01602	08954	127	91046	19751	131	80249	30786	133	69214	17
44	98572	127	01428	09132	130	90868	19933	134	80067	30972	136	69028	16
45	98746	130	01254	09310	133	90690	20116	137	79884	31158	139	68842	15
46	98920	133	01080	09488	136	90512	20298	140	79702	31344	143	68656	14
47	99094	136	00906	09667	139	90333	20480	143	79520	31530	146	68470	13
48	99269	139	00731	09845	142	90155	20662	146	79338	31716	149	68284	12
49	99443	142	00557	10023	145	89977	20844	149	79156	31903	152	68097	11
50	99617	145	00383	10202	148	89798	21027	152	78973	32089	155	67911	10
51	199792	147	1.800208	210380	151	1.789620	221209	155	1.778791	232275	158	1.767725	9
52	199966	150	1.800034	10559	154	89441	21392	158	78608	32462	161	67538	8
53	200141	153	1.799859	10737	157	89263	21574	161	78426	32648	164	67352	7
54	00315	156	99685	10916	160	89084	21757	164	78243	32835	167	67165	6
55	00490	159	99510	11095	163	88905	21940	167	78060	33021	171	66979	5
56	00665	162	99335	11273	166	88727	22122	170	77878	33208	174	66792	4
57	00840	165	99160	11452	169	88548	22305	173	77695	33395	177	66605	3
58	01015	168	98985	11631	172	88369	22488	176	77512	33582	180	66418	2
59	01189	171	98811	11810	175	88190	22671	179	77320	33769	183	66231	1
60	201364	174	1.798636	211989	178	1.788011	22854	182	1.777146	233956	186	1.766044	0
″ Vers.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	′ ″ Suv.
	143°			142°			141°			140°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	40°			41°			42°			43°			″ Suv.
	Versed.	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	
0	233956	0	1.766044	245290	0	1.754710	256855	0	1.743145	268646	0	1.731354	60
1	34143	3	65857	45481	3	54519	57050	3	42950	68845	3	31155	59
2	34330	6	65670	45672	6	54328	57245	7	42755	69043	7	30957	58
3	34517	9	65483	45863	10	54137	57439	10	42561	69242	10	30758	57
4	34704	13	65296	46054	13	53946	57634	13	42366	69440	13	30560	56
5	34891	16	65109	46245	16	53755	57829	17	42171	69639	16	30361	55
6	35079	19	64921	46437	19	53563	58024	20	41976	69838	20	30162	54
7	35266	22	64734	46628	22	53372	58219	23	41781	70037	23	29963	53
8	35453	25	64547	46819	25	53181	58414	26	41586	70235	26	29765	52
9	35641	28	64359	47011	28	52989	58609	29	41391	70434	29	29566	51
10	35829	31	64171	47202	32	52798	58805	33	41195	70633	33	29367	50
11	236016	34	1.763984	247394	35	1.752606	259000	36	1.741000	270832	36	1.729168	49
12	36204	38	63796	47585	38	52415	59195	39	40805	71031	39	28969	48
13	36392	41	63608	47777	41	52223	59391	42	40609	71230	42	28770	47
14	36580	44	63420	47968	44	52032	59586	45	40414	71430	46	28570	46
15	36768	47	63232	48160	48	51840	59782	49	40218	71629	50	28371	45
16	36956	50	63044	48352	51	51648	59977	52	40023	71828	53	28172	44
17	37141	53	62856	48544	54	51456	60173	55	39827	72028	56	27972	43
18	37332	57	62668	48736	57	51264	60369	58	39631	72227	60	27773	42
19	37520	60	62480	48928	60	51072	60565	62	39435	72427	63	27573	41
20	37708	63	62292	49120	64	50880	60761	65	39239	72626	66	27374	40
21	237896	66	1.762104	249312	67	1.750688	260957	68	1.739043	272826	70	1.727174	39
22	38085	69	61915	49504	70	50496	61152	71	38848	73026	73	26974	38
23	38273	72	61727	49697	73	50303	61349	75	38651	73225	76	26775	37
24	38462	75	61538	49889	76	50111	61545	78	38455	73425	80	26575	36
25	38650	78	61350	50081	80	49919	61741	81	38259	73625	83	26375	35
26	38839	82	61161	50274	83	49726	61937	84	38063	73825	86	26175	34
27	39028	85	60972	50466	86	49534	62133	88	37867	74025	90	25975	33
28	39216	88	60784	50659	89	49341	62330	91	37670	74225	93	25775	32
29	39405	91	60595	50852	92	49148	62526	94	37474	74425	96	25575	31
30	39594	94	60406	51044	96	48956	62723	98	37277	74626	100	25374	30
31	239783	98	1.760217	251237	101	1.748763	262919	103	1.737081	274826	104	1.725174	29
32	39972	101	60028	51430	104	48570	63116	106	36884	75026	107	24974	28
33	40161	105	59839	51623	107	48377	63313	110	36687	75227	110	24773	27
34	40350	108	59650	51816	110	48184	63509	113	36491	75427	113	24573	26
35	40539	111	59461	52009	113	47991	63706	116	36294	75628	117	24372	25
36	40729	114	59271	52202	117	47798	63903	119	36097	75828	120	24172	24
37	40918	117	59082	52395	120	47605	64100	123	35900	76029	123	23971	23
38	41107	120	58893	52588	123	47412	64297	126	35703	76229	127	23771	22
39	41297	123	58703	52782	126	47218	64494	129	35506	76430	130	23570	21
40	41486	127	58514	52975	129	47025	64691	132	35309	76631	134	23369	20
41	241676	130	1.758324	253168	133	1.746832	264888	135	1.735112	276832	137	1.723168	19
42	41866	133	58134	53362	136	46638	65085	139	34915	77033	141	22967	18
43	42055	136	57945	53555	139	46445	65283	142	34717	77234	144	22766	17
44	42245	139	57755	53749	142	46251	65480	145	34520	77435	147	22565	16
45	42435	142	57565	53943	145	46057	65677	149	34323	77636	150	22364	15
46	42625	146	57375	54136	149	45864	65875	152	34125	77837	154	22163	14
47	42815	149	57185	54330	152	45670	66073	155	33927	78038	157	21962	13
48	43005	152	56995	54524	155	45476	66270	158	33730	78240	161	21760	12
49	43195	155	56805	54718	159	45282	66468	162	33532	78441	164	21559	11
50	43385	158	56615	54912	162	45088	66666	165	33334	78643	168	21357	10
51	243575	161	1.756425	255106	166	1.744894	266863	169	1.733137	278844	171	1.721156	9
52	43766	165	56234	55300	169	44700	67061	172	32939	79046	174	20954	8
53	43956	168	56044	55494	172	44506	67259	175	32741	79247	177	20753	7
54	44146	171	55854	55688	175	44312	67457	178	32543	79449	181	20551	6
55	44337	174	55663	55883	178	44117	67655	182	32345	79651	184	20349	5
56	44528	177	55472	56077	181	43923	67853	185	32147	79852	188	20148	4
57	44718	180	55282	56272	184	43728	68051	188	31949	80054	191	19946	3
58	44909	184	55091	56466	188	43534	68250	191	31750	80256	194	19744	2
59	45100	187	54900	56661	191	43339	68448	194	31552	80458	197	19542	1
60	245290	190	1.754710	256855	194	1.743145	268646	197	1.731354	280660	201	1.719340	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed,	*Suvers.*	Parts for ″	Versed.	″ Suv.
	139°			138°			137°			136°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	44° Versed.	44° Parts for ″	44° Suvers.	45° Versed.	45° Parts for ″	45° Suvers.	46° Versed.	46° Parts for ″	46° Suvers.	47° Versed.	47° Parts for ″	47° Suvers.	″ Suv.
0	280660	0	1.719340	292893	0	1.707107	305342	0	1.694658	318002	0	1.681998	60
1	80862	3	19138	93099	3	06901	05551	3	94449	18214	4	81786	59
2	81064	7	18936	93305	7	06695	05760	7	94240	18427	7	81573	58
3	81267	10	18733	93511	10	06489	05970	11	94030	18640	10	81360	57
4	81469	14	18531	93716	14	06284	06179	14	93821	18853	14	81147	56
5	81671	17	1832	93922	17	06078	06389	18	93611	19066	18	80934	55
6	81874	20	1812	94128	21	05872	06598	21	93402	19279	21	80721	54
7	82076	24	17924	94334	24	05666	06808	25	93192	19492	25	80508	53
8	82279	27	17721	94541	28	05459	07017	28	92983	19705	28	80295	52
9	82481	31	17519	94747	31	05253	07227	32	92773	19919	32	80081	51
10	82684	34	17316	94953	34	05047	07437	35	92563	20132	36	79868	50
11	282887	38	1.717113	295159	38	1.704841	307647	39	1.692353	320345	39	1.679655	49
12	83089	41	16911	95366	41	04634	07857	42	92143	20559	43	79441	48
13	83292	45	16708	95572	45	04428	08067	46	91933	20772	46	79228	47
14	83495	48	16505	95779	48	04221	08277	49	91723	20986	50	79014	46
15	83698	51	16302	95985	52	04015	08487	52	91513	21199	53	78801	45
16	83901	55	16099	96192	55	03808	08697	56	91303	21413	57	78587	44
17	84104	58	15896	96399	59	03601	08907	59	91093	21627	60	78373	43
18	84307	62	15693	96605	62	03395	09118	63	90882	21840	64	78160	42
19	84510	65	15490	96812	66	03188	09328	66	90672	22054	67	77946	41
20	84714	68	15286	97019	69	02981	09538	70	90462	22268	71	77732	40
21	284917	72	1.715083	297226	73	1.702774	309749	73	1.690251	322482	74	1.677518	39
22	85120	75	14880	97433	76	02567	09959	77	90041	22696	78	77304	38
23	85324	79	14676	97640	80	02360	10170	80	89830	22910	81	77090	37
24	85527	82	14473	97847	83	02153	10380	84	89620	23124	85	76876	36
25	85731	85	14269	98054	86	01946	10591	87	89409	23338	89	76662	35
26	85934	88	14066	98261	90	01739	10802	91	89198	23552	92	76448	34
27	86138	92	13862	98469	93	01531	11013	94	88987	23767	96	76233	33
28	86342	96	13658	98676	97	01324	11224	98	88776	23981	99	76019	32
29	86546	99	13454	98883	100	01117	11434	101	88566	24195	103	75805	31
30	86750	102	13250	99091	103	00909	11645	105	88355	24410	107	75590	30
31	286953	106	1.713047	299298	107	1.700702	311856	110	1.688144	324624	111	1.675376	29
32	87157	109	12843	99506	111	00494	12068	113	87932	24839	115	75161	28
33	87361	112	12639	99713	114	00287	12279	117	87721	25053	118	74947	27
34	87566	116	12434	99921	118	1.700079	12490	120	87510	25268	122	74732	26
35	87770	119	12230	300129	121	1.699871	12701	124	87299	25483	125	74517	25
36	87974	123	12026	00337	125	99663	12912	127	87088	25698	129	74302	24
37	88178	126	11822	00545	128	99455	13124	131	86876	25912	133	74088	23
38	88383	130	11617	00752	132	99248	13335	134	86665	26127	136	73873	22
39	88587	133	11413	00960	135	99040	13547	138	86453	26342	140	73658	21
40	88791	137	11209	01168	139	98832	13758	141	86242	26557	143	73443	20
41	288996	140	1.711004	301377	142	1.698623	313970	144	1.686030	326772	147	1.673228	19
42	89201	143	10799	01585	145	98415	14182	148	85818	26987	151	73013	18
43	89405	146	10595	01793	149	98207	14393	152	85607	27203	154	72797	17
44	89610	150	10390	02001	152	97999	14605	156	85395	27418	158	72582	16
45	89815	153	10185	02210	156	97790	14817	159	85183	27633	161	72367	15
46	90019	157	09981	02418	159	97582	15029	163	84971	27849	165	72151	14
47	90224	160	09776	02626	163	97374	15241	167	84759	28064	169	71936	13
48	90429	164	09571	02835	166	97165	15453	170	84547	28279	172	71721	12
49	90634	167	09366	03043	170	96957	15665	174	84335	28495	176	71505	11
50	90839	171	09161	03252	173	96748	15877	177	84123	28710	179	71290	10
51	291044	174	1.708956	303461	177	1.696539	316089	181	1.683911	328926	183	1.671074	9
52	91250	177	08750	03670	180	96330	16302	184	83698	29142	186	70858	8
53	91455	181	08545	03878	184	96122	16514	188	83486	29358	190	70642	7
54	91660	184	08340	04087	187	95913	16726	191	83274	29573	193	70427	6
55	91865	188	08135	04296	191	95704	16939	195	83061	29789	197	70211	5
56	92071	191	07929	04505	194	95495	17151	198	82849	30005	201	69995	4
57	92276	195	07724	04714	198	95286	17364	202	82636	30221	204	69779	3
58	92482	198	07518	04923	201	95077	17576	205	82424	30437	208	69563	2
59	92688	202	07312	05132	205	94868	17789	209	82211	30653	211	69347	1
60	292893	205	1.707107	305342	208	1.694658	318002	212	1.681998	330869	214	1.669131	0
″ Vers.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	′ ″ Suv.
	135°			134°			133°			132°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	48°			49°			50°			51°			″ Suv.
	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers*	
0	330869	0	1.669131	343941	0	1.656059	357212	0	1.642788	370680	0	1.629320	60
1	31086	4	68914	44160	4	55840	57435	4	42565	70906	4	29094	59
2	31302	7	68698	44380	7	55620	57658	8	42342	71132	8	28868	58
3	31518	11	68482	44600	11	55400	57881	11	42119	71358	11	28642	57
4	31735	14	68265	44820	15	55180	58104	15	41896	71584	15	28416	56
5	31951	18	68049	45039	19	54961	58327	19	41673	71811	19	28189	55
6	32167	22	67833	45259	22	54741	58550	22	41450	72037	23	27963	54
7	32384	25	67616	45479	26	54521	58774	26	41226	72263	26	27737	53
8	32601	29	67399	45699	30	54301	58997	30	41003	72490	30	27510	52
9	32817	32	67183	45919	33	54081	59220	34	40780	72716	34	27284	51
10	33034	36	66966	46139	37	53861	59443	37	40557	72943	38	27057	50
11	333251	39	1.666749	346359	41	1.653641	359667	41	1.640333	373170	42	1.626830	49
12	33468	43	66532	46579	44	53421	59890	45	40110	73396	45	26604	48
13	33684	46	66316	46800	48	53200	60114	49	39886	73623	49	26377	47
14	33901	50	66099	47020	52	52980	60337	53	39663	73850	53	26150	46
15	34118	54	65882	47240	55	52760	60561	56	39439	74077	57	25923	45
16	34335	57	65665	47461	59	52539	60785	60	39215	74303	61	25697	44
17	34552	61	65448	47681	63	52319	61008	64	38992	74530	64	25470	43
18	34770	64	65230	47902	66	52098	61232	68	38768	74757	68	25243	42
19	34987	68	65013	48122	70	51878	61456	72	38544	74984	72	25016	41
20	35204	72	64796	48343	73	51657	61680	75	38320	75211	76	24789	40
21	335421	75	1.664579	348563	77	1.651437	361904	78	1.638096	375439	80	1.624561	39
22	35639	79	64361	48784	81	51216	62128	82	37872	75666	84	24334	38
23	35856	82	64144	49005	85	50995	62352	86	37648	75893	88	24107	37
24	36074	86	63926	49226	89	50774	62576	90	37424	76120	92	23880	36
25	36291	90	63709	49447	93	50553	62800	94	37200	76348	95	23652	35
26	36509	93	63491	49668	96	50332	63024	97	36976	76575	99	23425	34
27	36727	97	63273	49889	100	50111	63249	101	36751	76803	103	23197	33
28	36944	101	63056	50110	103	49890	63473	105	36527	77030	107	22970	32
29	37162	105	62838	50331	107	49669	63697	109	36303	77258	111	22742	31
30	37380	109	62620	50552	110	49448	63922	112	36078	77485	114	22515	30
31	337598	114	1.662402	350773	115	1.649227	364146	117	1.635854	377713	119	1.622287	29
32	37816	118	62184	50994	118	49006	64371	121	35629	77941	123	22059	28
33	38034	121	61966	51216	122	48784	64595	124	35405	78169	127	21831	27
34	38252	125	61748	51437	126	48563	64820	128	35180	78396	131	21604	26
35	38470	128	61530	51659	129	48341	65045	131	34955	78624	134	21376	25
36	38688	132	61312	51880	133	48120	65269	134	34731	78852	138	21148	24
37	38906	136	61094	52102	137	47898	65494	138	34506	79080	142	20920	23
38	39125	139	60875	52323	141	47677	65719	142	34281	79308	146	20692	22
39	39343	143	60657	52545	144	47455	65944	146	34056	79536	150	20464	21
40	39561	146	60439	52767	148	47233	66169	150	33831	79765	153	20235	20
41	339780	150	1.660220	352988	152	1.647012	366394	153	1.633606	379993	157	1.620007	19
42	39998	154	60002	53210	155	46790	66619	157	33381	80221	161	19779	18
43	40217	157	59783	53432	159	46568	66844	161	33156	80449	165	19551	17
44	40435	161	59565	53654	163	46346	67069	165	32931	80678	169	19322	16
45	40654	164	59346	53876	167	46124	67295	169	32705	80906	172	19094	15
46	40873	168	59127	54098	171	45902	67520	172	32480	81135	176	18865	14
47	41092	172	58908	54320	174	45680	67745	176	32255	81363	180	18637	13
48	41310	175	58690	54542	178	45458	67971	180	32029	81592	184	18408	12
49	41529	179	58471	54764	181	45236	68196	183	31804	81820	188	18180	11
50	41748	183	58252	54987	185	45013	68422	187	31578	82049	191	17951	10
51	341967	187	1.658033	355209	188	1.644791	368647	191	1.631353	382278	195	1.617722	9
52	42186	190	57814	55431	192	44569	68873	195	31127	82506	199	17494	8
53	42406	194	57594	55654	196	44346	69098	199	30902	82735	203	17265	7
54	42625	197	57375	55876	200	44124	69324	202	30676	82964	206	17036	6
55	42844	201	57156	56099	204	43901	69550	206	30450	83193	210	16807	5
56	43063	204	56937	56321	207	43679	69776	210	30224	83422	214	16578	4
57	43283	208	56717	56544	211	43456	70002	214	29998	83651	218	16349	3
58	43502	212	56498	56767	215	43233	70228	218	29772	83880	221	16120	2
59	43721	215	56279	56990	218	43010	70454	221	29546	84109	225	15891	1
60	343941	219	1.656059	357212	222	1.642788	370680	225	1.629320	384339	228	1.615661	0
″ Vers.	*Suvers.*	Parts for ″	Versed	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers*	Parts for ″	Versed.	′ ″ Suv.
	131°			130°			129°			128°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	52° Versed	Parts for ″	Suvers.	53° Versed	Parts for ′	Suvers.	54° Versed	Parts for ″	Suvers.	55° Versed	Parts for ″	Suvers.	″ Suv.
0	384339	0	1.615661	398185	0	1.601815	412215	0	1.587785	426424	0	1.573576	60
1	84568	4	15432	98417	4	01583	12450	4	87550	26662	4	73338	59
2	84797	8	15203	98650	8	01350	12685	8	87315	26900	8	73100	58
3	85026	12	14974	98882	12	01118	12921	12	87079	27139	12	72861	57
4	85256	16	14744	99115	16	00885	13156	16	86844	27377	16	72623	56
5	85485	19	14515	99347	19	00653	13392	20	86608	27616	20	72384	55
6	85715	23	14285	99580	23	00420	13628	24	86372	27854	24	72146	54
7	85944	27	14056	399812	27	1.600188	13863	28	86137	28093	28	71907	53
8	86174	31	13826	400045	31	1.599955	14099	32	85901	28331	32	71669	52
9	86404	35	13596	00278	35	99722	14335	36	85665	28570	36	71430	51
10	86633	38	13367	00511	39	99489	14571	39	85429	28809	40	71191	50
11	386863	42	1.613137	400744	43	1.599256	414806	43	1.585194	429048	44	1.570952	49
12	87093	46	12907	00976	47	99024	15042	47	84958	29286	48	70714	48
13	87323	50	12677	01209	50	98791	15278	51	84722	29525	52	70475	47
14	87553	54	12447	01442	54	98558	15514	55	84486	29764	56	70236	46
15	87783	57	12217	01675	58	98325	15750	59	84250	30003	60	69997	45
16	88013	61	11987	01908	62	98092	15986	63	84014	30242	64	69758	44
17	88243	65	11757	02142	66	97858	16223	67	83777	30481	68	69519	43
18	88473	69	11527	02375	70	97625	16459	71	83541	30720	72	69280	42
19	88703	73	11297	02608	74	97392	16695	75	83305	30960	76	69040	41
20	88933	77	11067	02841	78	97159	16931	79	83069	31199	80	68801	40
21	389164	81	1.610836	403075	82	1.596925	417168	83	1.582832	431438	84	1.568562	39
22	89394	85	10606	03308	86	96692	17404	87	82596	31677	88	68323	38
23	89624	89	10376	03542	90	96458	17640	91	82360	31917	92	68083	37
24	89855	92	10145	03775	94	96225	17877	95	82123	32156	96	67844	36
25	90085	96	09915	04009	98	95991	18114	99	81886	32396	100	67604	35
26	90316	100	09684	04242	102	95758	18350	103	81650	32635	104	67365	34
27	90546	104	09454	04476	106	95524	18587	107	81413	32875	108	67125	33
28	90777	108	09223	04710	110	95290	18824	111	81176	33114	112	66886	32
29	91008	111	08992	04943	114	95057	19060	115	80940	33354	116	66646	31
30	91239	115	08761	05177	117	94823	19297	118	80703	33594	120	66406	30
31	391469	119	1.608531	405411	121	1.594589	419534	122	1.580466	433834	124	1.566166	29
32	91700	123	08300	05645	125	94355	19771	126	80229	34073	128	65927	28
33	91931	127	08069	05879	129	94121	20008	130	79992	34313	132	65687	27
34	92162	131	07838	06113	133	93887	20245	134	79755	34553	136	65447	26
35	92393	135	07607	06347	137	93653	20482	138	79518	34793	140	65207	25
36	92624	139	07376	06581	141	93419	20719	142	79281	35033	144	64967	24
37	92855	143	07145	06815	145	93185	20956	146	79044	35273	148	64727	23
38	93086	147	06914	07049	149	92951	21193	150	78807	35513	152	64487	22
39	93318	151	06682	07284	153	92716	21430	154	78570	35753	156	64247	21
40	93549	154	06451	07518	156	92482	21668	158	78332	35993	160	64007	20
41	393780	158	1.606220	407752	160	1.592248	421905	162	1.578095	436234	164	1.563766	19
42	94012	162	05988	07987	164	92013	22142	166	77858	36474	168	63526	18
43	94243	166	05757	08221	168	91779	22380	170	77620	36714	172	63286	17
44	94474	170	05526	08456	172	91544	22617	174	77383	36955	176	63045	16
45	94706	174	05294	08690	176	91310	22855	178	77145	37195	180	62805	15
46	94938	178	05062	08925	180	91075	23092	182	76908	37436	184	62564	14
47	95169	182	04831	09160	184	90840	23330	186	76670	37676	188	62324	13
48	95401	186	04599	09394	188	90606	23568	190	76432	37917	192	62083	12
49	95633	190	04367	09629	192	90371	23805	194	76195	38157	196	61843	11
50	95864	194	04136	09864	195	90136	24043	198	75957	38398	200	61602	10
51	396096	197	1.603904	410099	199	1.589901	424281	202	1.575719	438639	204	1.561361	9
52	96328	201	03672	10334	203	89666	24519	206	75481	38879	208	61121	8
53	96560	205	03440	10569	207	89431	24757	210	75243	39120	212	60880	7
54	96792	209	03208	10804	211	89196	24995	214	75005	39361	216	60639	6
55	97024	213	02976	11039	215	88961	25233	218	74767	39602	220	60398	5
56	97256	217	02744	11274	219	88726	25471	222	74529	39843	224	60157	4
57	97488	220	02512	11509	223	88491	25709	226	74291	40084	228	59916	3
58	97720	224	02280	11744	227	88256	25947	230	74053	40325	232	59675	2
59	97953	228	02047	11979	231	88021	26185	234	73815	40566	236	59434	1
60	398185	231	1.601815	412215	234	1.587785	426424	237	1.573576	440807	240	1.559193	0
′ Vers.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	′ ″ Suv.
	127°			126°			125°			124°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′	56°			57°			58°			59°			″
″ Vers.	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Suv.
0	440807	0	1.559193	455361	0	1.544639	470081	0	1.529919	484962	0	1.515038	60
1	41048	4	58952	55605	4	44395	70327	4	29673	85211	4	14789	59
2	41290	8	58710	55849	8	44151	70574	8	29426	85461	8	14539	58
3	41531	12	58469	56093	12	43907	70821	12	29179	85710	12	14290	57
4	41772	16	58228	56337	16	43663	71068	17	28932	85960	17	14040	56
5	42013	20	57987	56581	20	43419	71315	21	28685	86209	21	13791	55
6	42255	24	57745	56826	24	43174	71562	25	28438	86459	25	13541	54
7	42496	28	57504	57070	28	42930	71809	29	28191	86708	29	13292	53
8	42738	32	57262	57314	32	42686	72056	33	27944	86958	33	13042	52
9	42979	36	57021	57558	37	42442	72303	37	27697	87208	37	12792	51
10	43221	40	56779	57803	41	42197	72550	41	27450	87457	42	12543	50
11	443463	45	1.556537	458047	45	1.541953	472797	45	1.527203	487707	46	1.512293	49
12	43704	49	56296	58292	49	41708	73044	49	26956	87957	50	12043	48
13	43946	53	56054	58536	53	41464	73291	54	26709	88207	54	11793	47
14	44188	57	55812	58781	57	41219	73539	58	26461	88457	58	11543	46
15	44430	61	55570	59025	61	40975	73786	62	26214	88707	63	11293	45
16	44672	65	55328	59270	65	40730	74033	66	25967	88957	67	11043	44
17	44914	69	55086	59515	69	40485	74281	70	25719	89207	71	10793	43
18	45156	73	54844	59760	73	40240	74528	74	25472	89457	75	10543	42
19	45398	77	54602	60004	77	39996	74776	78	25224	89707	79	10293	41
20	45640	81	54360	60249	81	39751	75023	82	24977	89957	83	10043	40
21	445882	85	1.554118	460494	86	1.539506	475271	87	1.524729	490208	87	1.509792	39
22	46124	89	53876	60739	90	39261	75519	91	24481	90458	91	09542	38
23	46366	93	53634	60984	94	39016	75766	95	24234	90708	95	09292	37
24	46608	97	53392	61229	98	38771	76014	99	23986	90959	99	09041	36
25	46851	101	53149	61474	102	38526	76262	103	23738	91209	104	08791	35
26	47093	105	52907	61719	106	38281	76510	107	23490	91459	108	08541	34
27	47336	109	52664	61965	110	38035	76758	111	23242	91710	112	08290	33
28	47578	113	52422	62210	114	37790	77005	115	22995	91960	117	08040	32
29	47820	117	52180	62455	118	37545	77253	119	22747	92211	121	07789	31
30	48063	122	51937	62700	122	37300	77501	124	22499	92462	126	07538	30
31	448306	126	1.551694	462946	127	1.537054	477749	128	1.522251	492712	130	1.507288	29
32	48548	130	51452	63191	131	36809	77998	132	22002	92963	134	07037	28
33	48791	134	51209	63437	135	36563	78246	136	21754	93214	138	06786	27
34	49034	138	50966	63682	139	36318	78494	141	21506	93464	142	06536	26
35	49276	142	50724	63928	143	36072	78742	145	21258	93715	146	06285	25
36	49519	146	50481	64173	148	35827	78990	149	21010	93966	151	06034	24
37	49762	150	50238	64419	152	35581	79239	153	20761	94217	155	05783	23
38	50005	154	49995	64664	156	35336	79487	158	20513	94468	159	05532	22
39	50248	158	49752	64910	160	35090	79735	162	20265	94719	163	05281	21
40	50491	162	49509	65156	164	34844	79984	166	20016	94970	168	05030	20
41	450734	166	1.549266	465402	168	1.534598	480232	170	1.519768	495221	172	1.504779	19
42	50977	171	49023	65648	172	34352	80481	174	19519	95472	176	04528	18
43	51220	175	48780	65893	176	34107	80729	178	19271	95723	180	04277	17
44	51464	179	48536	66139	180	33861	80978	182	19022	95975	184	04025	16
45	51707	183	48293	66385	184	33615	81227	186	18773	96226	188	03774	15
46	51950	187	48050	66631	189	33369	81475	190	18525	96477	193	03523	14
47	52193	191	47807	66878	193	33122	81724	195	18276	96729	197	03271	13
48	52437	195	47563	67124	197	32876	81973	199	18027	96980	201	03020	12
49	52680	199	47320	67370	201	32630	82222	203	17778	97231	205	02769	11
50	52924	203	47076	67616	205	32384	82471	207	17529	97483	210	02517	10
51	453167	207	1.546833	467862	209	1.532138	482720	212	1.517280	497734	214	1.502266	9
52	53411	211	46589	68109	213	31891	82969	216	17031	97986	218	02014	8
53	53654	215	46346	68355	217	31645	83218	220	16782	98238	222	01762	7
54	53898	219	46102	68601	221	31399	83467	224	16533	98489	226	01511	6
55	54142	223	45858	68848	226	31152	83716	228	16284	98741	230	01259	5
56	54385	227	45615	69094	230	30906	83965	233	16035	98993	235	01007	4
57	54629	231	45371	69341	234	30659	84214	237	15786	99244	239	00756	3
58	54873	235	45127	69587	238	30413	84463	241	15537	99496	243	00504	2
59	55117	239	44883	69834	242	30166	84713	245	15287	99748	247	00252	1
60	455361	243	1.544639	470081	246	1.529919	484962	249	1.515038	500000	251	1.500000	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	123°			122°			121°			120°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′	60°			61°			62°			63°			
″ Vers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed.	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	″ Suv.
0	500000	0	1.500000	515190	0	1.484810	530528	0	1.469472	546009	0	1.453991	60
1	00252	4	1.499748	15445	4	84555	30785	4	69215	46269	4	53731	59
2	00504	8	99496	15699	8	84301	31042	8	68958	46528	9	53472	58
3	00756	12	99244	15954	13	84046	31299	13	68701	46787	13	53213	57
4	01008	17	98992	16208	17	83792	31556	17	68444	47046	17	52954	56
5	01260	21	98740	16463	21	83537	31813	21	68187	47306	22	52694	55
6	01512	25	98488	16718	25	83282	32070	26	67930	47565	26	52435	54
7	01764	30	98236	16972	30	83028	32327	30	67673	47825	30	52175	53
8	02017	34	97983	17227	34	82773	32584	34	67416	48084	35	51916	52
9	02269	38	97731	17482	38	82518	32842	38	67158	48344	39	51656	51
10	02521	42	97479	17737	43	82263	33099	43	66901	48603	43	51397	50
11	502774	46	1.497226	517991	47	1.482009	533356	47	1.466644	548863	48	1.451137	49
12	03026	50	96974	18246	51	81754	33613	51	66387	49122	52	50878	48
13	03278	54	96722	18501	55	81499	33871	55	66129	49382	56	50618	47
14	03531	58	96469	18756	59	81244	34128	60	65872	49642	61	50358	46
15	03783	63	96217	19011	63	80989	34385	64	65615	49902	65	50098	45
16	04036	67	95964	19266	67	80734	34643	68	65357	50161	69	49839	44
17	04289	71	95711	19521	72	80479	34900	72	65100	50421	74	49579	43
18	04541	75	95459	19776	76	80224	35158	77	64842	50681	78	49319	42
19	04794	79	95206	20032	80	79968	35415	81	64585	50941	82	49059	41
20	05047	84	94953	20287	85	79713	35673	85	64327	51201	87	48799	40
21	505299	88	1.494701	520542	89	1.479458	535931	90	1.464069	551461	91	1.448539	39
22	05552	92	94448	20797	93	79203	36188	94	63812	51721	95	48279	38
23	05805	96	94195	21053	97	78947	36446	98	63554	51981	100	48019	37
24	06058	100	93942	21308	101	78692	36704	103	63296	52241	104	47759	36
25	06311	105	93689	21564	106	78436	36962	107	63038	52501	108	47499	35
26	06564	109	93436	21819	110	78181	37220	111	62780	52761	113	47239	34
27	06817	113	93183	22074	115	77926	37477	115	62523	53021	117	46979	33
28	07070	117	92930	22330	119	77670	37735	120	62265	53282	121	46718	32
29	07323	121	92677	22586	123	77414	37993	124	62007	53542	126	46458	31
30	07576	126	92424	22841	128	77159	38251	129	61749	53802	130	46198	30
31	507830	131	1.492170	523097	132	1.476903	538509	133	1.461491	554062	134	1.445938	29
32	08083	135	91917	23353	136	76647	38767	138	61233	54323	139	45677	28
33	08336	140	91664	23608	141	76392	39026	142	60974	54583	143	45417	27
34	08589	144	91411	23864	145	76136	39284	146	60716	54844	147	45156	26
35	08843	148	91157	24120	149	75880	39542	151	60458	55104	152	44896	25
36	09096	152	90904	24376	154	75624	39800	155	60200	55365	156	44635	24
37	09350	156	90650	24632	158	75368	40058	159	59942	55625	160	44375	23
38	09603	161	90397	24888	162	75112	40317	164	59683	55886	165	44114	22
39	09857	165	90143	25144	166	74856	40575	168	59425	56147	169	43853	21
40	10110	169	89890	25400	171	74600	40833	172	59167	56407	174	43593	20
41	510364	173	1.489636	525656	175	1.474344	541092	177	1.458908	556668	178	1.443332	19
42	10617	178	89383	25912	179	74088	41350	181	58650	56929	182	43071	18
43	10871	182	89129	26168	183	73832	41609	185	58391	57190	187	42810	17
44	11125	186	88875	26424	187	73576	41867	189	58133	57450	191	42550	16
45	11379	190	88621	26680	192	73320	42126	194	57874	57711	195	42289	15
46	11633	195	88367	26937	196	73063	42385	198	57615	57972	199	42028	14
47	11886	199	88114	27193	200	72807	42643	202	57357	58233	204	41767	13
48	12140	203	87860	27449	204	72551	42902	207	57098	58494	208	41506	12
49	12394	207	87606	27706	208	72294	43161	211	56839	58755	212	41245	11
50	12648	212	87352	27962	213	72038	43420	215	56580	59016	217	40984	10
51	512902	216	1.487098	528218	217	1.471782	543678	220	1.456322	559277	221	1.440723	9
52	13156	220	86844	28475	221	71525	43937	224	56063	59538	226	40462	8
53	13410	224	86590	28731	225	71269	44196	228	55804	59800	230	40200	7
54	13665	229	86335	28988	230	71012	44455	233	55545	60061	234	39939	6
55	13919	233	86081	29245	234	70755	44714	237	55286	60322	239	39678	5
56	14173	237	85827	29501	238	70499	44973	241	55027	60583	243	39417	4
57	14427	241	85573	29758	242	70242	45232	246	54768	60845	247	39155	3
58	14682	245	85318	30015	247	69985	45491	250	54509	61106	251	38894	2
59	14936	249	85064	30272	251	69728	45750	254	54250	61367	256	38633	1
60	515190	254	1.484810	530528	256	1.469472	546009	258	1.453991	561629	260	1.438371	0
″ Vers.	Suvers.	Parts for ″	Versed	Suvers.	Parts for ″	Versed	Suvers.	Parts for ″	Versed	Suvers.	Parts for ″	Versed	′ ″ Suv.
	119°			118°			117°			116°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	64°			65°			66°			67°			″ Suv.
	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	
0	561629	0	1.438371	577382	0	1.422618	593263	0	1.406737	609269	0	1.390731	60
1	61890	4	38110	77645	4	22355	93529	4	06471	09537	4	90463	59
2	62152	9	37848	77909	9	22091	93795	9	06205	09804	9	90196	58
3	62413	13	37587	78173	13	21827	94061	13	05939	10072	13	89928	57
4	62675	17	37325	78437	18	21563	94327	18	05673	10340	18	89660	56
5	62937	22	37063	78700	22	21300	94592	22	05408	10608	22	89392	55
6	63198	26	36802	78964	26	21036	94858	27	05142	10876	27	89124	54
7	63460	31	36540	79228	31	20772	95124	31	04876	11144	31	88856	53
8	63722	35	36278	79492	35	20508	95390	36	04610	11412	36	88588	52
9	63983	39	36017	79756	40	20244	95656	40	04344	11680	40	88320	51
10	64245	44	35755	80020	44	19980	95922	44	04078	11948	45	88052	50
11	564507	48	1.435493	580284	48	1.419716	596189	49	1.403811	612216	49	1.387784	49
12	64769	52	35231	80548	53	19452	96455	53	03545	12484	54	87516	48
13	65031	57	34969	80812	57	19188	96721	58	03279	12753	58	87247	47
14	65293	61	34707	81076	62	18924	96987	62	03013	13021	63	86979	46
15	65555	66	34445	81340	66	18660	97253	66	02747	13289	67	86711	45
16	65817	70	34183	81604	71	18396	97520	71	02480	13557	72	86443	44
17	66079	74	33921	81869	75	18131	97786	76	02214	13826	76	86174	43
18	66341	79	33659	82133	79	17867	98052	80	01948	14094	81	85906	42
19	66603	83	33397	82397	84	17603	98319	85	01681	14362	85	85638	41
20	66865	87	33135	82661	88	17339	98585	89	01415	14631	89	85369	40
21	567127	92	1.432873	582926	92	1.417074	598851	94	1.401149	614899	93	1.385101	39
22	67390	96	32610	83190	97	16810	99118	98	00882	15168	98	84832	38
23	67652	100	32348	83455	101	16545	99384	103	00616	15436	102	84564	37
24	67914	105	32086	83719	106	16281	99651	107	00349	15705	107	84295	36
25	68177	109	31823	83984	110	16016	99917	112	1.400083	15973	111	84027	35
26	68439	113	31561	84248	114	15752	600184	116	1.399816	16242	116	83758	34
27	68701	118	31299	84513	119	15487	00451	121	99549	16510	121	83490	33
28	68964	122	31036	84777	123	15223	00717	125	99283	16779	125	83221	32
29	69226	126	30774	85042	128	14958	00984	129	99016	17048	130	82952	31
30	69489	131	30511	85307	132	14693	01251	133	98749	17317	134	82683	30
31	569751	136	1.430249	585571	137	1.414429	601518	138	1.398482	617585	139	1.382415	29
32	70014	140	29986	85836	141	14164	01784	142	98216	17854	143	82146	28
33	70277	145	29723	86101	146	13899	02051	147	97949	18123	148	81877	27
34	70539	149	29461	86366	150	13634	02318	151	97682	18392	152	81608	26
35	70802	153	29198	86631	154	13369	02585	156	97415	18661	157	81339	25
36	71065	158	28935	86896	159	13104	02852	160	97148	18930	161	81070	24
37	71328	162	28672	87160	163	12840	03119	165	96881	19199	166	80801	23
38	71590	167	28410	87425	168	12575	03386	169	96614	19468	170	80532	22
39	71853	171	28147	87690	172	12310	03653	174	96347	19737	175	80263	21
40	72116	175	27884	87955	177	12045	03920	178	96080	20006	179	79994	20
41	572379	180	1.427621	588220	181	1.411780	604187	182	1.395813	620275	184	1.379725	19
42	72642	184	27358	88486	185	11514	04454	187	95546	20544	188	79456	18
43	72905	189	27095	88751	189	11249	04722	191	95278	20813	193	79187	17
44	73168	193	26832	89016	194	10984	04989	196	95011	21082	197	78918	16
45	73431	197	26569	89281	199	10719	05256	200	94744	21351	202	78649	15
46	73694	202	26306	89546	203	10454	05523	205	94477	21621	206	78379	14
47	73957	206	26043	89812	207	10188	05791	209	94209	21890	211	78110	13
48	74221	210	25779	90077	212	09923	06058	214	93942	22159	215	77841	12
49	74484	215	25516	90342	216	09658	06325	218	93675	22429	220	77571	11
50	74747	219	25253	90608	221	09392	06593	223	93407	22698	224	77302	10
51	575010	224	1.424990	590873	225	1.409127	606860	227	1.393140	622967	229	1.377033	9
52	75274	228	24726	91138	230	08862	07128	231	92872	23237	233	76763	8
53	75537	232	24463	91404	234	08596	07395	236	92605	23506	238	76494	7
54	75801	237	24199	91669	239	08331	07663	240	92337	23776	242	76224	6
55	76064	241	23936	91935	243	08065	07930	245	92070	24045	247	75955	5
56	76327	245	23673	92201	247	07799	08198	249	91802	24315	251	75685	4
57	76591	250	23409	92466	252	07534	08466	254	91534	24584	256	75416	3
58	76854	254	23146	92732	256	07268	08733	258	91267	24854	260	75146	2
59	77118	259	22882	92998	260	07002	09001	263	90999	25124	265	74876	1
60	577382	263	1.422618	593263	265	1.406737	609269	267	1.390731	625393	269	1.374607	0
″ Vers.	*Suvers*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	115°			114°			113°			112°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″	68°			69°			70°			71°			″
Vers.	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	*Suv.*
0	625393	0	1.374607	641632	0	1.358368	657980	0	1.342020	674432	0	1.325568	60
1	25663	5	74337	41904	5	58096	58253	5	41747	74707	5	25293	59
2	25933	9	74067	42175	9	57825	58527	9	41473	74982	9	25018	58
3	26203	14	73797	42447	14	57553	58800	14	41200	75257	14	24743	57
4	26472	18	73528	42719	18	57281	59073	18	40927	75532	18	24468	56
5	26742	23	73258	42990	23	57010	59347	23	40653	75807	23	24193	55
6	27012	27	72988	43262	27	56738	59620	27	40380	76083	27	23917	54
7	27282	32	72718	43534	32	56466	59894	32	40106	76358	32	23642	53
8	27552	36	72448	43806	36	56194	60167	36	39833	76633	37	23367	52
9	27822	41	72178	44077	41	55923	60441	41	39559	76908	41	23092	51
10	28092	45	71908	44349	46	55651	60715	46	39285	77184	46	22816	50
11	628362	50	1.371638	644621	50	1.355379	660988	50	1.339012	677459	51	1.322541	49
12	28632	54	71368	44893	54	55107	61262	55	38738	77734	55	22266	48
13	28902	59	71098	45165	59	54835	61536	59	38464	78010	60	21990	47
14	29172	63	70828	45437	63	54563	61809	64	38191	78285	64	21715	46
15	29443	68	70557	45709	68	54291	62083	68	37917	78560	69	21440	45
16	29713	72	70287	45981	73	54019	62357	73	37643	78836	74	21164	44
17	29983	77	70017	46253	77	53747	62631	78	37369	79111	78	20889	43
18	30253	81	69747	46525	82	53475	62905	82	37095	79387	83	20613	42
19	30523	86	69477	46797	87	53203	63179	87	36821	79663	87	20337	41
20	30794	90	69206	47069	91	52931	63452	91	36548	79938	92	20062	40
21	631064	95	1.368936	647342	96	1.352658	663726	96	1.336274	680214	96	1.319786	39
22	31335	100	68665	47614	100	52386	64000	100	36000	80489	101	19511	38
23	31605	104	68395	47886	105	52114	64274	105	35726	80765	106	19235	37
24	31875	108	68125	48158	109	51842	64548	109	35452	81041	110	18959	36
25	32146	113	67854	48431	114	51569	64822	114	35178	81316	115	18684	35
26	32416	117	67584	48703	118	51297	65097	118	34903	81592	119	18408	34
27	32687	122	67313	48975	123	51025	65371	123	34629	81868	124	18132	33
28	32957	126	67043	49248	127	50752	65645	127	34355	82144	128	17856	32
29	33228	131	66772	49520	132	50480	65919	132	34081	82419	133	17581	31
30	33499	135	66501	49793	136	50207	66193	137	33807	82695	138	17305	30
31	633769	140	1.366231	650065	141	1.349935	666467	142	1.333533	682971	143	1.317029	29
32	34040	144	65960	50338	145	49662	66742	146	33258	83247	147	16753	28
33	34311	149	65689	50610	150	49390	67016	151	32984	83523	152	16477	27
34	34582	153	65418	50883	155	49117	67290	155	32710	83799	157	16201	26
35	34852	158	65148	51155	159	48845	67564	160	32436	84075	161	15925	25
36	35123	162	64877	51428	164	48572	67839	165	32161	84351	166	15649	24
37	35394	167	64606	51701	168	48299	68113	169	31887	84627	171	15373	23
38	35665	171	64335	51973	173	48027	68388	173	31612	84903	175	15097	22
39	35936	176	64064	52246	177	47754	68662	178	31338	85179	180	14821	21
40	36207	180	63793	52519	182	47481	68937	183	31063	85455	184	14545	20
41	636478	185	1.363522	652791	186	1.347209	669211	187	1.330789	685731	189	1.314269	19
42	36749	189	63251	53064	191	46936	69486	192	30514	86007	193	13993	18
43	37020	194	62980	53337	195	46663	69760	197	30240	86284	198	13716	17
44	37291	198	62709	53610	200	46390	70035	201	29965	86560	202	13440	16
45	37562	203	62438	53883	205	46117	70309	206	29691	86836	207	13164	15
46	37833	207	62167	54156	209	45844	70584	210	29416	87112	212	12888	14
47	38104	212	61896	54429	214	45571	70859	215	29141	87389	216	12611	13
48	38375	216	61625	54702	218	45298	71133	220	28867	87665	221	12335	12
49	38647	221	61353	54975	223	45025	71408	224	28592	87941	225	12059	11
50	38918	226	61082	55248	228	44752	71683	229	28317	88218	230	11782	10
51	639189	230	1.360811	655521	232	1.344479	671958	234	1.328042	688494	235	1.311506	9
52	39460	235	60540	55794	237	44206	72232	238	27768	88771	239	11229	8
53	39732	239	60268	56067	241	43933	72507	243	27493	89047	244	10953	7
54	40003	244	59997	56340	246	43660	72782	247	27218	89324	248	10676	6
55	40275	248	59725	56613	250	43387	73057	252	26943	89600	253	10400	5
56	40546	253	59454	56887	255	43113	73332	256	26668	89877	258	10123	4
57	40817	257	59183	57160	259	42840	73607	261	26393	90153	262	09847	3
58	41089	262	58911	57433	264	42567	73882	265	26118	90430	267	09570	2
59	41360	266	58640	57706	268	42294	74157	270	25843	90706	271	09294	1
60	641632	271	1.358368	657980	273	1.342020	674432	274	1.325568	690983	276	1.309017	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ *Sun.*
	111°			110°			109°			108°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′	72°			73°			74°			75°			
″ Vers.	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ′	*Suvers.*	Versed	Parts for ″	*Suvers.*	″ *Suv.*
0	690983	0	1.309017	707628	0	1.292372	724363	0	1.275637	741181	0	1.258819	60
1	91260	5	08740	07906	5	92094	24642	5	75358	41462	5	58538	59
2	91536	9	08464	08185	9	91815	24922	9	75078	41743	9	58257	58
3	91813	14	08187	08463	14	91537	25202	14	74798	42024	14	57976	57
4	92090	18	07910	08741	19	91259	25481	19	74519	42305	19	57695	56
5	92367	23	07633	09019	23	90981	25761	23	74239	42586	23	57414	55
6	92643	28	07357	09298	28	90702	26041	28	73959	42867	28	57133	54
7	92920	32	07080	09576	32	90424	26321	33	73679	43148	33	56852	53
8	93197	37	06803	09854	37	90146	26600	37	73400	43429	37	56571	52
9	93474	42	06526	10133	42	89867	26880	42	73120	43711	42	56289	51
10	93751	46	06249	10411	46	89589	27160	47	72840	43992	47	56008	50
11	694028	51	1.305972	710690	51	1.289310	727440	51	1.272560	744273	52	1.255727	49
12	94305	55	05695	10968	56	89032	27720	56	72280	44554	56	55446	48
13	94582	60	05418	11247	60	88753	28000	61	72000	44835	61	55165	47
14	94859	65	05141	11525	65	88475	28280	65	71720	45117	66	54883	46
15	95136	69	04864	11804	70	88196	28560	70	71440	45398	70	54602	45
16	95413	74	04587	12082	74	87918	28839	75	71161	45679	75	54321	44
17	95690	78	04310	12361	79	87639	29119	79	70881	45961	80	54039	43
18	95967	83	04033	12639	84	87361	29400	84	70600	46242	84	53758	42
19	96244	88	03756	12918	88	87082	29680	89	70320	46523	89	53477	41
20	96521	92	03479	13197	93	86803	29960	93	70040	46805	94	53195	40
21	696798	97	1.303202	713475	98	1.286525	730240	98	1.269760	747086	98	1.252914	39
22	97076	102	02924	13754	102	86246	30520	103	69480	47368	103	52632	38
23	97353	106	02647	14033	107	85967	30800	107	69200	47649	108	52351	37
24	97630	111	02370	14312	112	85688	31080	112	68920	47931	113	52069	36
25	97907	116	02093	14590	116	85410	31360	117	68640	48212	117	51788	35
26	98185	120	01815	14869	121	85131	31641	121	68359	48494	122	51506	34
27	98462	125	01538	15148	126	84852	31921	126	68079	48775	127	51225	33
28	98739	130	01261	15427	130	84573	32201	131	67799	49057	131	50943	32
29	99017	134	00983	15706	135	84294	32481	135	67519	49338	136	50662	31
30	99294	139	00706	15985	139	84015	32762	140	67238	49620	141	50380	30
31	699572	143	1.300428	716264	144	1.283736	733042	145	1.266958	749902	146	1.250098	29
32	699849	148	1.300151	16542	149	83458	33322	150	66678	50183	150	49817	28
33	700127	153	1.299873	16821	154	83179	33603	154	66397	50465	155	49535	27
34	00404	157	99596	17100	158	82900	33883	159	66117	50747	160	49253	26
35	00682	162	99318	17379	163	82621	34163	164	65837	51028	165	48972	25
36	00959	167	99041	17658	168	82342	34444	169	65556	51310	169	48690	24
37	01237	171	98763	17938	172	82062	34724	173	65276	51592	174	48408	23
38	01514	176	98486	18217	177	81783	35005	178	64995	51874	179	48126	22
39	01792	181	98208	18496	182	81504	35285	183	64715	52155	183	47845	21
40	02070	185	97930	18775	186	81225	35566	187	64434	52437	188	47563	20
41	702347	190	1.297653	719054	191	1.280946	735846	192	1.264154	752719	193	1.247281	19
42	02625	195	97375	19333	196	80667	36127	197	63873	53001	198	46999	18
43	02903	199	97097	19612	200	80388	36407	201	63593	53283	202	46717	17
44	03181	204	96819	19892	205	80108	36688	206	63312	53565	207	46435	16
45	03458	208	96542	20171	210	79829	36969	211	63031	53847	212	46153	15
46	03736	213	96264	20450	214	79550	37249	215	62751	54129	216	45871	14
47	04014	218	95986	20730	219	79270	37530	220	62470	54411	221	45589	13
48	04292	222	95708	21009	224	78991	37811	225	62189	54693	225	45307	12
49	04570	227	95430	21288	228	78712	38091	230	61909	54975	230	45025	11
50	04848	231	95152	21568	233	78432	38372	234	61628	55257	235	44743	10
51	705126	236	1.294874	721847	238	1.278153	738653	239	1.261347	755539	240	1.244461	9
52	05404	241	94596	22126	242	77874	38934	244	61066	55821	245	44179	8
53	05682	245	94318	22406	247	77594	39215	248	60785	56103	249	43897	7
54	05960	250	94040	22685	252	77315	39495	253	60505	56385	254	43615	6
55	06238	254	93762	22965	256	77035	39776	258	60224	56667	259	43333	5
56	06516	259	93484	23244	261	76756	40057	262	59943	56949	263	43051	4
57	06794	264	93206	23524	266	76476	40338	267	59662	57231	268	42769	3
58	07072	268	92928	23803	270	76197	40619	272	59381	57514	273	42486	2
59	07350	273	92650	24083	275	75917	40900	276	59100	57796	277	42204	1
60	707628	277	1.292372	724363	279	1.275637	741181	281	1.258819	758078	282	1.241922	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ *Suv.*
	107°			106°			105°			104°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′	76°			77°			78°			79°			
″ Vers.	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	″ Suv.
0	758078	0	1.241922	775049	0	1.224951	792088	0	1.207912	809191	0	1.190809	60
1	58360	5	41640	75332	5	24668	92373	5	07627	09477	5	90523	59
2	58643	9	41357	75616	9	24384	92657	9	07343	09762	10	90238	58
3	58925	14	41075	75899	14	24101	92942	14	07058	10048	14	89952	57
4	59207	19	40793	76183	19	23817	93227	19	06773	10333	19	89667	56
5	59490	24	40510	76466	24	23534	93511	24	06489	10619	24	89381	55
6	59772	28	40228	76750	28	23250	93796	28	06204	10905	29	89095	54
7	60054	33	39946	77033	33	22967	94080	33	05920	11190	33	88810	53
8	60337	38	39663	77317	38	22683	94365	38	05635	11476	38	88524	52
9	60619	43	39381	77601	43	22399	94650	43	05350	11761	43	88239	51
10	60902	47	39098	77884	47	22116	94934	47	05066	12047	48	87953	50
11	761184	52	1.238816	778168	52	1.221832	795219	52	1.204781	812333	52	1.187667	49
12	61466	57	38534	78451	57	21549	95504	57	04496	12619	57	87381	48
13	61749	61	38251	78735	62	21265	95789	62	04211	12904	62	87096	47
14	62032	66	37968	79019	66	20981	96073	66	03927	13190	67	86810	46
15	62314	71	37686	79303	71	20697	96358	71	03642	13476	71	86524	45
16	62597	75	37403	79586	76	20414	96643	76	03357	13762	76	86238	44
17	62879	80	37121	79870	81	20130	96928	81	03072	14048	81	85952	43
18	63162	85	36838	80154	85	19846	97213	85	02787	14333	86	85667	42
19	63444	90	36556	80438	90	19562	97498	90	02502	14619	91	85381	41
20	63727	94	36273	80721	95	19279	97782	95	02218	14905	95	85095	40
21	764010	99	1.235990	781005	100	1.218995	798067	100	1.201933	815191	100	1.184809	39
22	64292	104	35708	81289	104	18711	98352	104	01648	15477	105	84523	38
23	64575	109	35425	81573	109	18427	98637	109	01363	15763	110	84237	37
24	64858	113	35142	81857	114	18143	98922	114	01078	16049	115	83951	36
25	65141	118	34859	82141	119	17859	99207	119	00793	16335	119	83665	35
26	65423	123	34577	82425	123	17575	99492	123	00508	16620	124	83380	34
27	65706	127	34294	82708	128	17292	799777	128	1.200223	16906	129	83094	33
28	65989	132	34011	82992	133	17008	800062	133	1.199938	17192	134	82808	32
29	66272	137	33728	83276	138	16724	00347	138	99653	17478	138	82522	31
30	66555	141	33445	83560	142	16440	00632	143	99368	17764	143	82236	30
31	766837	146	1.233163	783844	147	1.216156	800917	147	1.199083	818050	148	1.181950	29
32	67120	151	32880	84128	152	15872	01202	152	98798	18336	153	81664	28
33	67403	156	32597	84412	157	15588	01487	157	98513	18623	157	81377	27
34	67686	161	32314	84696	161	15304	01772	162	98228	18909	162	81091	26
35	67969	165	32031	84981	166	15019	02057	166	97943	19195	167	80805	25
36	68252	170	31748	85265	171	14735	02343	171	97657	19481	172	80519	24
37	68535	175	31465	85549	176	14451	02628	176	97372	19767	176	80233	23
38	68818	179	31182	85833	180	14167	02913	181	97087	20053	181	79947	22
39	69101	184	30899	86117	185	13883	03198	185	96802	20339	186	79661	21
40	69384	189	30616	86401	190	13599	03483	190	96517	20625	191	79375	20
41	769667	194	1.230333	786685	195	1.213315	803769	195	1.196231	820912	195	1.179088	19
42	69950	198	30050	86970	199	13030	04054	200	95946	21198	200	78802	18
43	70233	203	29767	87254	204	12746	04339	205	95661	21484	205	78516	17
44	70516	208	29484	87538	209	12462	04624	209	95376	21770	210	78230	16
45	70800	213	29200	87822	213	12178	04910	214	95090	22056	214	77944	15
46	71083	217	28917	88107	218	11893	05195	219	94805	22343	219	77657	14
47	71366	222	28634	88391	223	11609	05480	224	94520	22629	224	77371	13
48	71649	227	28351	88675	228	11325	05766	228	94234	22915	229	77085	12
49	71932	232	28068	88960	232	11040	06051	233	93949	23202	234	76798	11
50	72216	236	27784	89244	237	10756	06336	238	93664	23488	238	76512	10
51	772499	241	1.227501	789528	242	1.210472	806622	243	1.193378	823774	243	1.176226	9
52	72782	246	27218	89813	247	10187	06907	247	93093	24060	248	75940	8
53	73065	250	26935	90097	251	09903	07193	252	92807	24347	253	75653	7
54	73349	255	26651	90381	256	09619	07478	257	92522	24633	257	75367	6
55	73632	260	26368	90666	261	09334	07763	262	92237	24920	262	75080	5
56	73915	265	26085	90950	266	09050	08049	267	91951	25206	267	74794	4
57	74199	269	25801	91235	270	08765	08334	271	91666	25492	272	74508	3
58	74482	274	25518	91519	275	08481	08620	276	91380	25779	276	74221	2
59	74765	279	25235	91804	280	08196	08905	281	91095	26065	281	73935	1
60	775049	283	1.224951	792088	284	1.207912	809191	285	1.190809	826352	286	1.173648	0
″ Vers.	*Suvers.*	Parts for ″	Versed	*Suvers.*	Parts for ″	Versed	*Suvers.*	Parts for ″	Versed	*Suvers.*	Parts for ″	Versed	′ ″ Suv.
	103°			102°			101°			100°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

″ Vers.	80°			81°			82°			83°			″ Suv.
	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	Versed.	Parts for ″	*Suvers.*	
0	826352	0	1.173648	843565	0	1.156435	860827	0	1.139173	878131	0	1.121869	60
1	26638	5	73362	43853	5	56147	61115	5	38885	78419	5	21581	59
2	26925	10	73075	44140	10	55860	61403	10	38597	78708	10	21292	58
3	27211	14	72789	44427	14	55573	61691	14	38309	78997	14	21003	57
4	27498	19	72502	44715	19	55285	61979	19	38021	79286	19	20714	56
5	27784	24	72216	45002	24	54998	62267	24	37733	79574	24	20426	55
6	28071	29	71929	45290	29	54710	62555	29	37445	79863	29	20137	54
7	28357	33	71643	45577	33	54423	62844	34	37156	80152	34	19848	53
8	28644	38	71356	45864	38	54136	63132	38	36868	80441	39	19559	52
9	28931	43	71069	46152	43	53848	63420	43	36580	80730	43	19270	51
10	29217	48	70783	46439	48	53561	63708	48	36292	81018	48	18982	50
11	829504	52	1.170496	846727	53	1.153273	863996	53	1.136004	881307	53	1.118693	49
12	29790	57	70210	47014	57	52986	64284	58	35716	81596	58	18404	48
13	30077	62	69923	47302	62	52693	64573	62	35427	81885	63	18115	47
14	30364	67	69636	47589	67	52411	64861	67	35139	82174	67	17826	46
15	30650	72	69350	47877	72	52123	65149	72	34851	82163	72	17537	45
16	30937	76	69063	48164	77	51836	65437	77	34563	82751	77	17249	44
17	31224	81	68776	48452	81	51548	65726	82	34274	83040	82	16960	43
18	31511	86	68489	48739	86	51261	66014	86	33986	83329	87	16671	42
19	31797	91	68203	49027	91	50973	66302	91	33698	83618	91	16382	41
20	32084	96	67916	49314	96	50686	66590	96	33410	83907	96	16093	40
21	832371	100	1.167629	849602	101	1.150398	866879	101	1.133121	884196	101	1.115804	39
22	32658	105	67342	49889	106	50111	67167	106	32833	84485	106	15515	38
23	32944	110	67056	50177	111	49823	67455	110	32545	84774	111	15226	37
24	33231	115	66769	50465	116	49535	67744	115	32256	85063	116	14937	36
25	33518	119	66482	50752	120	49248	68032	120	31968	85352	120	14648	35
26	33805	124	66195	51040	125	48960	68320	125	31680	85641	125	14359	34
27	34092	129	65908	51328	130	48672	68609	130	31391	85930	130	14070	33
28	34379	134	65621	51615	135	48385	68897	134	31103	86219	135	13781	32
29	34665	138	65335	51903	140	48097	69185	139	30815	86508	140	13492	31
30	34952	143	65048	52191	144	47809	69474	144	30526	86797	144	13203	30
31	835239	148	1.164761	852478	149	1.147522	869762	149	1.130238	887086	149	1.112914	29
32	35526	153	64474	52766	153	47234	70051	154	29949	87375	154	12625	28
33	35813	158	64187	53054	158	46946	70339	159	29661	87664	159	12336	27
34	36100	163	63900	53341	163	46659	70627	163	29373	87953	164	12047	26
35	36387	167	63613	53629	168	46371	70916	168	29084	88242	169	11758	25
36	36674	172	63326	53917	172	46083	71204	173	28796	88531	174	11469	24
37	36961	177	63039	54205	177	45795	71493	178	28507	88820	179	11180	23
38	37248	182	62752	54492	182	45508	71781	183	28219	89109	184	10891	22
39	37535	187	62465	54780	187	45220	72070	187	27930	89398	189	10602	21
40	37822	191	62178	55068	192	44932	72358	192	27642	89687	193	10313	20
41	838109	196	1.161891	855356	196	1.144644	872647	197	1.127353	889977	198	1.110023	19
42	38396	201	61604	55644	201	44356	72935	202	27065	90266	203	09734	18
43	38683	206	61317	55932	206	44068	73224	207	26776	90555	208	09445	17
44	38970	210	61030	56219	211	43781	73512	212	26488	90844	212	09156	16
45	39257	215	60743	56507	215	43493	73801	216	26199	91133	217	08867	15
46	39544	220	60456	56795	220	43205	74090	221	25910	91422	222	08578	14
47	39832	225	60168	57083	225	42917	74378	226	25622	91711	227	08289	13
48	40119	230	59881	57371	230	42629	74667	231	25333	92001	231	07999	12
49	40406	234	59594	57659	235	42341	74955	236	25045	92290	236	07710	11
50	40693	239	59307	57947	240	42053	75244	240	24756	92579	241	07421	10
51	840980	244	1.159020	858235	244	1.141765	875533	245	1.124467	892868	246	1.107132	9
52	41267	249	58733	58523	249	41477	75821	250	24179	93157	250	06843	8
53	41555	254	58445	58811	251	41189	76110	255	23890	93447	255	06553	7
54	41842	258	58158	59099	259	40901	76398	260	23602	93736	260	06264	6
55	42129	263	57871	59387	264	40613	76687	264	23313	94025	265	05975	5
56	42416	268	57584	59675	268	40325	76976	269	23024	94314	270	05686	4
57	42704	273	57296	59963	273	40537	77264	274	22736	94604	275	05396	3
58	42991	277	57009	60251	278	39749	77553	279	22447	94893	279	05107	2
59	43278	282	56722	60539	283	39461	77842	284	22158	95182	284	04818	1
60	843565	287	1.156435	860827	287	1.139173	878131	288	1.121869	895471	289	1.104529	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	99°			98°			97°			96°			

Natural Versed and Suversed Sines.

′ ″ Vers.	84°			85°			86°			87°			″ Suv.
	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	Versed	Parts for ″	Suvers.	
0	895471	0	1.104529	912844	0	1.087156	930213	0	1.069757	947664	0	1.052336	60
1	95761	5	04239	13134	5	86866	30534	5	69466	47954	5	52046	59
2	96050	10	03950	13424	10	86576	30824	10	69176	48245	10	51755	58
3	96339	14	03661	13714	15	86286	31114	15	68886	48535	15	51465	57
4	96629	19	03371	14003	19	85997	31404	19	68596	48826	19	51174	56
5	96918	24	03082	14293	24	85707	31694	24	68306	49116	24	50884	55
6	97207	29	02793	14583	29	85417	31985	29	68015	49407	29	50593	54
7	97497	34	02503	14873	34	85127	32275	34	67725	49698	34	50302	53
8	97786	39	02214	15163	39	84837	32565	39	67435	49988	39	50012	52
9	98075	44	01925	15453	44	84547	32855	44	67145	50279	44	49721	51
10	98365	48	01635	15742	48	84258	33146	48	66854	50569	48	49431	50
11	898654	53	1.101346	916032	53	1.083968	933436	53	1.066564	950860	53	1.049140	49
12	98944	58	01056	16322	58	83678	33726	58	66274	51150	58	48850	48
13	99233	63	00767	16612	63	83388	34016	63	65984	51441	63	48559	47
14	99522	68	00478	16902	68	83098	34307	68	65693	51731	68	48269	46
15	899812	72	1.100188	17192	73	82808	34597	73	65403	52022	73	47978	45
16	900101	77	1.099899	17482	77	82518	34887	77	65113	52312	77	47688	44
17	00391	82	99609	17772	82	82228	35177	82	64823	52603	82	47397	43
18	00680	87	99320	18061	87	81939	35468	87	64532	52893	87	47107	42
19	00970	92	99030	18351	92	81649	35758	92	64242	53184	92	46816	41
20	01259	97	98741	18641	97	81359	36048	97	63952	53475	97	46525	40
21	901549	102	1.098451	918931	102	1.081069	936339	102	1.063661	953765	102	1.046235	39
22	01838	107	98162	19221	107	80779	36629	106	63371	54056	106	45944	38
23	02128	112	97872	19511	112	80489	36919	111	63081	54346	111	45654	37
24	02417	116	97583	19801	116	80199	37209	116	62791	54637	116	45363	36
25	02707	121	97293	20091	121	79909	37500	121	62500	54928	121	45072	35
26	02996	126	97004	20381	126	79619	37790	126	62210	55218	126	44782	34
27	03286	131	96714	20671	131	79329	38080	131	61920	55509	131	44491	33
28	03575	136	96425	20961	136	79039	38371	136	61629	55799	136	44201	32
29	03865	141	96135	21251	141	78749	38661	140	61339	56090	140	43910	31
30	04154	145	95846	21541	145	78459	38951	145	61049	56381	145	43619	30
31	904444	150	1.095556	921831	150	1.078169	939242	150	1.060758	956671	150	1.043329	29
32	04733	155	95267	22121	155	77879	39532	155	60468	56962	155	43038	28
33	05023	160	94977	22411	160	77589	39822	160	60178	57252	160	42748	27
34	05312	164	94688	22701	164	77299	40113	165	59887	57543	165	42457	26
35	05602	169	94398	22991	169	77009	40493	169	59597	57834	169	42166	25
36	05892	174	94108	23281	174	76719	40694	174	59306	58124	174	41876	24
37	06181	179	93819	23571	179	76429	40984	179	59016	58415	179	41585	23
38	06471	184	93529	23861	184	76139	41274	184	58726	58706	184	41294	22
39	06760	189	93240	24151	189	75849	41565	189	58435	58996	189	41004	21
40	07050	193	92950	24441	193	75559	41855	194	58145	59287	194	40713	20
41	907340	198	1.092660	924731	198	1.075269	942146	198	1.057854	959578	198	1.040422	19
42	07629	203	92371	25021	203	74979	42436	203	57564	59868	203	40132	18
43	07919	208	92081	25311	208	74689	42726	208	57274	60159	208	39841	17
44	08209	213	91791	25601	213	74399	43017	213	56983	60449	213	39551	16
45	08498	218	91502	25891	218	74109	43307	218	56693	60740	218	39260	15
46	08788	222	91212	26182	222	73818	43598	223	56402	61031	223	38969	14
47	09078	227	90922	26472	227	73528	43888	227	56112	61321	227	38679	13
48	09367	232	99633	26762	232	73238	44178	232	55822	61612	232	38388	12
49	09657	237	90343	27052	237	72948	44469	237	55531	61903	237	38097	11
50	09947	242	90053	27342	242	72658	44759	212	55241	62193	242	37807	10
51	910236	247	1.089764	927632	247	1.072368	945050	247	1.054950	962484	247	1.037516	9
52	10526	252	89474	27922	252	72078	45340	252	54660	62775	252	37225	8
53	10816	257	89184	28212	257	71788	45631	257	54369	63966	257	36934	7
54	11106	261	88894	28503	261	71497	45921	261	54079	63356	261	36644	6
55	11395	266	88605	28793	266	71207	46212	266	53788	63647	266	36353	5
56	11685	271	88315	29083	271	70917	46502	271	53498	63938	271	36062	4
57	11975	276	88025	29373	276	70627	46793	276	53207	64228	276	35772	3
58	12265	281	87735	29663	281	70337	47083	281	52917	64519	281	35481	2
59	12554	285	87446	29953	285	70047	47374	286	52626	64810	286	35190	1
60	912844	290	1.087156	930243	290	1.069757	947664	290	1.052336	965101	290	1.034899	0
″ Vers.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	Suvers.	Parts for ″	Versed.	′ ″ Suv.
	95°			94°			93°			92°			

TABLE XXXVI.

Natural Versed and Suversed Sines.

′ ″ Vers.	88°			89°			″ Suv.
	Versed	Parts for ″	*Suvers.*	Versed	Parts for ″	*Suvers.*	
0	965101	0	1.034899	0.982548	0	1.017452	60
1	65391	5	34609	82838	5	17162	59
2	65682	10	34318	83129	10	16871	58
3	65973	15	34027	83420	15	16580	57
4	66263	19	33737	83711	19	16289	56
5	66554	24	33446	84002	24	15998	55
6	66845	29	33155	84293	29	15707	54
7	67136	34	32864	84583	34	15417	53
8	67426	39	32574	84874	39	15126	52
9	67717	44	32283	85165	44	14835	51
10	68008	48	31992	85456	49	14544	50
11	968298	53	1.031702	0.985747	53	1.014253	49
12	68589	58	31411	86038	58	13962	48
13	68880	63	31120	86329	63	13671	47
14	69171	68	30829	86619	68	13381	46
15	69461	73	30539	86910	73	13090	45
16	69752	78	30248	87201	78	12799	44
17	70043	82	29957	87492	83	12508	43
18	70334	87	29666	87783	87	12217	42
19	70624	92	29376	88074	92	11926	41
20	70915	97	29085	88365	97	11635	40
21	971206	102	1.028794	0.988656	102	1.011344	39
22	71497	107	28503	88946	107	11054	38
23	71788	111	28212	89237	112	10763	37
24	72078	116	27922	89528	116	10472	36
25	72369	121	27631	89819	121	10181	35
26	72660	126	27340	90110	126	09890	34
27	72951	131	27049	90401	131	09599	33
28	73241	136	26759	90692	136	09308	32
29	73532	141	26468	90983	141	09017	31
30	73823	145	26177	91273	145	08727	30
31	974114	150	1.025886	0.991564	150	1.008436	29
32	74405	155	25595	91855	155	08145	28
33	74695	160	25305	92146	160	07854	27
34	74986	165	25014	92437	165	07563	26
35	75277	170	24723	92728	170	07272	25
36	75568	175	24432	93019	175	06981	24
37	75859	179	24141	93310	179	06690	23
38	76149	184	23851	93600	184	06400	22
39	76440	189	23560	93891	189	06109	21
40	76731	194	23269	94182	194	05818	20
41	977022	199	1.022978	0.994473	199	1.005527	19
42	77313	204	22687	94764	204	05236	18
43	77603	208	22397	95055	209	04945	17
44	77894	213	22106	95346	213	04654	16
45	78185	218	21815	95637	218	04363	15
46	78476	223	21524	95928	223	04072	14
47	78767	228	21233	96218	228	03782	13
48	79058	233	20942	96509	233	03491	12
49	79348	238	20652	96800	238	03200	11
50	79639	242	20361	97091	243	02909	10
51	979930	247	1.020070	0.997382	247	1.002618	9
52	80221	252	19779	97673	252	02327	8
53	80512	257	19488	97964	257	02036	7
54	80803	262	19197	98255	262	01745	6
55	81093	267	18907	98546	267	01454	5
56	81384	271	18616	98836	272	01164	4
57	81675	276	18325	99127	276	00873	3
58	81966	281	18034	99418	281	00582	2
59	82257	286	17743	0.999709	286	00291	1
60	982548	291	1.017452	1.000000	291	1.000000	0
″ Vers.	*Suvers.*	Parts for ″	Versed.	*Suvers.*	Parts for ″	Versed.	′ ″ Suv.
	91°			90°			

TABLE XXXVII.

For reducing SIDEREAL to MEAN SOLAR TIME.

Hrs.	Min.	Sec.	Min.	Sec.	Sec.	Sec.
1	0	9.83	1	0.16	1	0.00
2	0	19.66	2	0.33	2	0.01
3	0	29.49	3	0.49	3	0.01
4	0	39.32	4	0.66	4	0.01
5	0	49.15	5	0.82	5	0.01
6	0	58.98	6	0.98	6	0.02
7	1	8.81	7	1.15	7	0.02
8	1	18.64	8	1.31	8	0.02
9	1	28.47	9	1.47	9	0.02
10	1	38.30	10	1.64	10	0.03
11	1	48.13	11	1.80	11	0.03
12	1	57.96	12	1.97	12	0.03
13	2	7.78	13	2.13	13	0.04
14	2	17.61	14	2.29	14	0.04
15	2	27.44	15	2.46	15	0.04
16	2	37.27	16	2.62	16	0.04
17	2	47.10	17	2.78	17	0.05
18	2	56.93	18	2.95	18	0.05
19	3	6.76	19	3.11	19	0.05
20	3	16.59	20	3.28	20	0.05
21	3	26.42	30	4.91	30	0.08
22	3	36.25	40	6.55	40	0.11
23	3	46.08	50	8.19	50	0.14
24	3	55.91	60	9.83	60	0.16

TABLE XXXVIII.

For reducing MEAN SOLAR to SIDEREAL TIME.

Hrs.	Min.	Sec.	Min.	Sec.	Sec.	Sec.
1	0	9.86	1	0.16	1	0.00
2	0	19.71	2	0.33	2	0.01
3	0	29.57	3	0.49	3	0.01
4	0	39.43	4	0.66	4	0.01
5	0	49.28	5	0.82	5	0.01
6	0	59.14	6	0.99	6	0.02
7	1	8.99	7	1.15	7	0.02
8	1	18.85	8	1.31	8	0.02
9	1	28.71	9	1.48	9	0.02
10	1	38.56	10	1.64	10	0.03
11	1	48.42	11	1.81	11	0.03
12	1	58.28	12	1.97	12	0.03
13	2	8.13	13	2.14	13	0.04
14	2	17.99	14	2.30	14	0.04
15	2	27.85	15	2.46	15	0.04
16	2	37.70	16	2.63	16	0.04
17	2	47.56	17	2.79	17	0.05
18	2	57.42	18	2.96	18	0.05
19	3	7.27	19	3.12	19	0.05
20	3	17.13	20	3.28	20	0.05
21	3	26.99	30	4.93	30	0.08
22	3	36.84	40	6.57	40	0.11
23	3	46.70	50	8.21	50	0.14
24	3	56.55	60	9.86	60	0.16

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	3°	4°	5°	6°	7°	
53′ 0″	9.999839	9727	9612	9496	9380	193
10	9838	9725	9610	9494	9377	193
20	9836	9722	9608	9491	9374	194
30	9835	9721	9606	9489	9371	194
40	9833	9720	9604	9486	9369	195
50	9832	9718	9602	9484	9366	195
54 0	9.999831	9716	9599	9481	9363	196
10	9829	9714	9597	9479	9360	196
20	9828	9713	9595	9476	9357	197
30	9827	9711	9593	9474	9354	197
40	9826	9709	9591	9471	9351	198
50	9824	9707	9589	9469	9348	199
55 0	9.999823	9706	9587	9466	9345	200
10	9821	9704	9584	9464	9342	200
20	9820	9702	9582	9461	9339	201
30	9819	9700	9580	9459	9337	201
40	9817	9699	9578	9456	9334	202
50	9816	9697	9576	9454	9331	202
56 0	9.999815	9695	9574	9451	9328	203
10	9813	9693	9571	9449	9325	203
20	9812	9692	9569	9447	9322	204
30	9811	9690	9567	9444	9320	205
40	9809	9688	9565	9442	9317	205
50	9808	9686	9563	9439	9314	206
57 0	9.999807	9685	9561	9437	9311	207
10	9805	9683	9559	9434	9308	207
20	9804	9681	9557	9432	9305	208
30	9803	9680	9555	9429	9303	209
40	9801	9678	9553	9427	9300	209
50	9800	9676	9551	9424	9297	210
58 0	9.999799	9675	9549	9422	9294	211
10	9797	9673	9546	9419	9291	211
20	9796	9671	9544	9417	9288	212
30	9794	9669	9542	9414	9286	212
40	9793	9668	9540	9412	9283	213
50	9791	9666	9538	9409	9280	214
59 0	9.999790	9664	9536	9407	9277	214
10	9789	9662	9533	9404	9274	215
20	9787	9661	9531	9402	9271	216
30	9786	9659	9529	9399	9268	217
40	9785	9657	9527	9397	9265	217
50	9783	9655	9525	9394	9262	218
60 0	9.999782	9653	9523	9392	9259	218
10	9781	9652	9520	9389	9257	219
20	9779	9650	9518	9387	9254	219
30	9778	9648	9516	9384	9251	220
40	9777	9646	9514	9382	9248	220
50	9775	9645	9512	9379	9245	221
61 0	9.999774	9643	9510	9376	9242	222
10	9772	9641	9507	9374	9239	223
20	9771	9639	9505	9371	9236	223
30	9769	9638	9503	9369	9233	224
40	9768	9636	9501	9366	9230	225
50	9766	9634	9499	9364	9227	225
62 0	9.999765	9632	9497	9361	9224	226

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	0	0	1	1	1	1	2	2	2	

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff to 100′
	8°	9°	10°	11°	12°	
53′ 0″	9.999264	9148	9032	8917	8803	192
10	9261	9144	9028	8913	8798	192
20	9257	9140	9024	8908	8794	193
30	9254	9137	9021	8904	8789	194
40	9251	9133	9017	8900	8784	194
50	9247	9129	9013	8895	8779	195
54 0	9.999244	9126	9009	8891	8774	196
10	9241	9122	9005	8887	8770	197
20	9238	9119	9001	8882	8765	197
30	9234	9115	8997	8878	8760	198
40	9231	9112	8993	8874	8756	199
50	9228	9108	8989	8869	8751	199
55 0	9.999225	9105	8985	8865	8746	200
10	9222	9101	8981	8860	8742	201
20	9219	9098	8977	8856	8737	201
30	9216	9094	8973	8852	8732	202
40	9212	9091	8969	8847	8727	202
50	9209	9087	8965	8843	8722	203
56 0	9.999206	9083	8961	8839	8718	203
10	9203	9079	8957	8834	8713	204
20	9199	9076	8953	8830	8708	205
30	9196	9072	8949	8826	8704	205
40	9193	9069	8945	8821	8699	206
50	9190	9065	8941	8817	8694	206
57 0	9.999186	9062	8937	8813	8690	207
10	9183	9058	8934	8808	8685	208
20	9180	9055	8930	8804	8680	209
30	9176	9051	8926	8800	8676	210
40	9173	9048	8922	8795	8671	211
50	9170	9044	8918	8791	8666	212
58 0	9.999167	9040	8914	8787	8662	212
10	9163	9037	8910	8782	8657	213
20	9160	9033	8906	8778	8652	213
30	9157	9029	8902	8774	8648	214
40	9154	9026	8898	8769	8643	214
50	9151	9022	8894	8765	8638	215
59 0	9.999147	9018	8890	8761	8634	215
10	9144	9014	8886	8756	8629	216
20	9141	9011	8882	8752	8624	216
30	9137	9007	8878	8748	8619	217
40	9134	9004	8874	8743	8615	217
50	9131	9000	8870	8739	8610	218
60 0	9.999128	8997	8866	8735	8605	218
10	9124	8993	8862	8730	8600	219
20	9121	8990	8858	8726	8596	220
30	9118	8986	8854	8722	8591	220
40	9115	8982	8850	8717	8586	221
50	9112	8979	8846	8713	8581	222
61 0	9.999108	8975	8842	8709	8577	222
10	9105	8971	8838	8704	8572	223
20	9102	8968	8834	8700	8567	223
30	9098	8964	8830	8695	8562	224
40	9095	8960	8826	8691	8558	224
50	9092	8957	8822	8687	8553	225
62 0	9.999089	8953	8818	8683	8548	225

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	0	1	1	1	2	2	2	3	3	

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	13°	14°	15°	16°	17°	
53′ 0″	9.998688	8574	8461	8348	8236	188
10	8683	8569	8455	8342	8230	189
20	8678	8563	8449	8336	8223	190
30	8673	8558	8443	8329	8217	191
40	8668	8553	8437	8323	8210	191
50	8663	8547	8432	8317	8203	192
54 0	9.998658	8542	8426	8311	8197	192
10	8653	8537	8420	8305	8190	193
20	8648	8531	8414	8299	8184	193
30	8643	8526	8409	8293	8177	194
40	8638	8521	8403	8287	8171	195
50	8633	8515	8397	8281	8164	195
55 0	9.998628	8510	8391	8275	8158	196
10	8623	8504	8386	8269	8151	196
20	8618	8498	8380	8262	8145	197
30	8613	8493	8374	8256	8138	197
40	8607	8488	8368	8250	8132	198
50	8602	8482	8363	8244	8125	198
56 0	9.998597	8477	8357	8238	8119	199
10	8592	8471	8351	8232	8112	199
20	8587	8466	8345	8225	8106	200
30	8582	8460	8339	8219	8099	201
40	8577	8455	8334	8213	8093	201
50	8572	8449	8328	8207	8086	202
57 0	9.998567	8444	8322	8201	8080	202
10	8562	8439	8316	8195	8073	203
20	8557	8433	8311	8189	8067	203
30	8552	8428	8305	8183	8060	204
40	8546	8423	8299	8177	8054	205
50	8541	8418	8294	8171	8047	206
58 0	9.998536	8412	8288	8165	8041	206
10	8531	8407	8282	8159	8034	207
20	8526	8401	8276	8152	8028	207
30	8521	8396	8271	8146	8021	208
40	8516	8391	8265	8140	8015	209
50	8511	8385	8259	8134	8008	209
59 0	9.998506	8380	8253	8128	8002	210
10	8501	8374	8247	8122	7995	211
20	8496	8369	8241	8115	7989	211
30	8491	8363	8235	8109	7982	212
40	8486	8358	8230	8103	7976	212
50	8481	8352	8224	8097	7969	213
60 0	9.998476	8347	8218	8091	7963	213
10	8471	8341	8212	8085	7956	214
20	8466	8336	8206	8078	7950	215
30	8461	8330	8201	8072	7943	215
40	8455	8325	8195	8066	7937	216
50	8450	8319	8189	8060	7930	216
61 0	9.998445	8314	8183	8054	7924	217
10	8440	8308	8177	8047	7917	217
20	8435	8303	8171	8041	7911	218
30	8430	8297	8165	8035	7904	218
40	8425	8292	8160	8029	7898	219
50	8420	8286	8154	8023	7891	219
62 0	9.998415	8281	8149	8017	7885	220

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	1	1	2	2	3	4	4	5	5	

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	18°	19°	20°	21°	22°	
53′ 0″	9.998124	8013	7902	7792	7684	184
10	8117	8006	7895	7784	7675	185
20	8110	7998	7887	7776	7667	185
30	8104	7991	7880	7769	7659	186
40	8097	7984	7872	7761	7651	186
50	8090	7977	7865	7753	7643	187
54 0	9.998083	7970	7857	7745	7635	187
10	8076	7963	7850	7737	7626	188
20	8069	7955	7842	7730	7618	188
30	8063	7948	7835	7722	7610	189
40	8056	7941	7827	7714	7602	189
50	8049	7934	7820	7706	7594	190
55 0	9.998042	7927	7812	7698	7586	190
10	8035	7920	7805	7690	7577	191
20	8028	7913	7798	7683	7569	191
30	8022	7905	7790	7675	7561	192
40	8015	7898	7782	7667	7553	192
50	8008	7891	7775	7659	7545	193
56 0	9.998001	7884	7767	7651	7537	193
10	7994	7877	7760	7644	7528	194
20	7987	7869	7752	7636	7520	194
30	7981	7862	7745	7628	7512	195
40	7974	7855	7737	7620	7504	196
50	7967	7848	7730	7612	7495	196
57 0	9.997960	7841	7722	7604	7487	197
10	7953	7834	7715	7596	7479	198
20	7946	7826	7707	7588	7470	198
30	7940	7819	7700	7580	7462	199
40	7933	7812	7692	7572	7454	200
50	7926	7805	7685	7564	7446	200
58 0	9.997919	7798	7677	7556	7438	201
10	7912	7790	7670	7549	7429	201
20	7905	7783	7662	7541	7421	202
30	7899	7776	7655	7533	7413	203
40	7892	7769	7647	7525	7405	203
50	7885	7762	7640	7517	7396	204
59 0	9.997878	7754	7632	7509	7388	204
10	7871	7747	7625	7501	7380	205
20	7864	7740	7617	7493	7371	205
30	7858	7733	7610	7486	7363	206
40	7851	7725	7602	7478	7355	206
50	7844	7718	7594	7470	7347	207
60 0	9.997837	7711	7586	7462	7339	207
10	7830	7704	7579	7454	7330	208
20	7823	7696	7571	7446	7322	208
30	7817	7689	7564	7438	7314	209
40	7810	7682	7556	7430	7306	210
50	7803	7675	7549	7422	7297	211
61 0	9.997796	7667	7541	7414	7290	211
10	7789	7660	7534	7407	7281	212
20	7782	7653	7526	7399	7273	213
30	7775	7646	7519	7391	7265	214
40	7768	7638	7511	7383	7257	214
50	7761	7631	7504	7375	7248	215
62 0	9.997754	7624	7496	7367	7240	216

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	1	1	2	3	4	4	5	6	6	

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center 23°	24°	25°	26°	27°	Diff. to 100′	Moon's Hor. Par.	App. Alt. Moon's Center. 28°	29°	30°	31°	32°	Diff. to 100′
53′ 0″	9.997576	7468	7362	7256	7152	176	53′ 0″	9.997048	6945	6844	6743	6643	168
10	7568	7459	7353	7247	7142	177	10	7038	6935	6833	6732	6632	169
20	7559	7450	7344	7238	7132	177	20	7028	6924	6822	6721	6620	169
30	7550	7442	7334	7228	7122	178	30	7017	6914	6812	6710	6609	170
40	7541	7433	7325	7218	7112	179	40	7007	6903	6801	6699	6597	170
50	7533	7424	7316	7209	7102	179	50	6997	6893	6790	6688	6586	171
54 0	9.997524	7415	7307	7199	7092	180	54 0	9.996987	6882	6779	6676	6574	172
10	7516	7406	7297	7190	7082	180	10	6977	6872	6768	6665	6563	172
20	7507	7397	7288	7180	7072	181	20	6966	6861	6757	6654	6551	173
30	7499	7388	7279	7171	7063	182	30	6956	6850	6746	6643	6540	173
40	7490	7380	7270	7161	7053	182	40	6946	6840	6735	6632	6528	174
50	7482	7371	7260	7152	7043	183	50	6936	6829	6724	6620	6517	174
55 0	9.997473	7362	7251	7142	7033	183	55 0	9.996926	6819	6713	6609	6505	175
10	7464	7353	7242	7132	7023	184	10	6915	6808	6703	6597	6494	176
20	7456	7344	7233	7123	7013	184	20	6905	6798	6692	6586	6482	176
30	7447	7335	7223	7113	7003	185	30	6895	6787	6681	6575	6471	177
40	7439	7326	7214	7103	6993	186	40	6885	6776	6670	6564	6459	177
50	7430	7318	7205	7094	6983	186	50	6875	6766	6659	6553	6418	178
56 0	9.997421	7309	7196	7084	6973	187	56 0	9.996861	6755	6648	6541	6436	178
10	7413	7300	7187	7075	6964	187	10	6854	6745	6638	6530	6425	179
20	7404	7291	7177	7065	6954	188	20	6844	6734	6627	6519	6413	179
30	7396	7282	7168	7056	6944	188	30	6834	6724	6616	6508	6402	180
40	7387	7273	7159	7046	6934	189	40	6824	6713	6605	6497	6390	181
50	7379	7264	7149	7037	6924	189	50	6813	6703	6594	6486	6379	181
57 0	9.997370	7255	7140	7027	6914	190	57 0	9.996803	6692	6583	6474	6367	182
10	7361	7246	7131	7018	6904	190	10	6793	6682	6573	6463	6356	182
20	7353	7237	7122	7008	6894	191	20	6783	6671	6562	6452	6344	183
30	7344	7228	7113	6999	6884	191	30	6772	6661	6551	6441	6333	184
40	7336	7220	7103	6989	6875	192	40	6762	6650	6540	6430	6321	184
50	7327	7211	7094	6980	6865	192	50	6752	6640	6529	6418	6310	185
58 0	9.997319	7202	7085	6970	6855	193	58 0	9.996742	6629	6518	6407	6298	185
10	7310	7193	7076	6961	6845	193	10	6731	6619	6508	6396	6287	186
20	7302	7184	7066	6951	6835	194	20	6721	6608	6497	6385	6275	186
30	7293	7175	7057	6942	6825	194	30	6711	6597	6486	6374	6264	187
40	7284	7166	7048	6932	6815	195	40	6701	6587	6475	6362	6252	187
50	7276	7157	7039	6923	6805	195	50	6690	6576	6464	6351	6241	188
59 0	9.997267	7148	7029	6913	6795	196	59 0	9.996680	6566	6453	6340	6229	188
10	7259	7139	7020	6904	6785	196	10	6670	6555	6442	6329	6218	189
20	7250	7130	7011	6894	6775	197	20	6659	6544	6431	6318	6206	189
30	7241	7122	7002	6884	6766	198	30	6649	6534	6420	6307	6195	190
40	7233	7113	6992	6875	6756	198	40	6639	6523	6409	6295	6183	190
50	7224	7104	6983	6865	6746	199	50	6629	6513	6398	6284	6172	191
60 0	9.997216	7095	6974	6855	6736	199	60 0	9.996619	6502	6387	6273	6160	191
10	7207	7086	6965	6846	6726	200	10	6608	6492	6377	6262	6149	192
20	7199	7077	6955	6836	6716	201	20	6598	6481	6366	6251	6137	192
30	7190	7068	6946	6827	6706	201	30	6588	6471	6355	6239	6126	193
40	7182	7060	6937	6817	6696	202	40	6578	6460	6344	6228	6114	193
50	7173	7051	6928	6808	6686	202	50	6567	6449	6333	6217	6103	194
61 0	9.997164	7042	6918	6798	6676	203	61 0	9.996557	6439	6322	6206	6091	194
10	7156	7033	6909	6788	6666	204	10	6547	6428	6312	6195	6080	195
20	7147	7024	6900	6779	6657	205	20	6537	6418	6301	6184	6068	195
30	7139	7015	6891	6769	6647	205	30	6526	6407	6290	6172	6057	196
40	7130	7006	6882	6759	6637	206	40	6516	6397	6279	6161	6045	197
50	7122	6997	6872	6749	6627	206	50	6506	6386	6268	6150	6034	197
62 0	9.997113	6988	6863	6740	6617	207	62 0	9.996496	6376	6257	6139	6022	198

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
(23°–27°)	1	2	3	3	4	5	6	7	8	Sub.
(28°–32°)	1	2	3	4	6	7	8	9	10	Sub.

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	33°	34°	35°	36°	37°	
53′ 0″	9.996545	6447	6351	6256	6162	159
10	6533	6435	6338	6243	6149	159
20	6521	6423	6326	6230	6136	160
30	6509	6411	6314	6217	6123	161
40	6497	6399	6301	6205	6110	161
50	6485	6386	6289	6192	6097	162
54 0	9.996474	6374	6276	6179	6084	162
10	6462	6362	6264	6167	6071	163
20	6450	6350	6252	6154	6058	163
30	6438	6338	6239	6141	6045	164
40	6427	6326	6227	6128	6032	164
50	6415	6314	6214	6116	6019	165
55 0	9.996403	6302	6202	6103	6006	165
10	6391	6290	6189	6091	5993	166
20	6379	6277	6177	6079	5980	166
30	6368	6265	6165	6065	5967	167
40	6356	6253	6152	6052	5954	167
50	6344	6241	6140	6039	5941	168
56 0	9.996332	6229	6127	6027	5928	168
10	6321	6217	6115	6014	5915	169
20	6309	6205	6102	6001	5902	169
30	6297	6193	6090	5989	5889	170
40	6285	6180	6078	5976	5876	170
50	6273	6168	6065	5963	5863	171
57 0	9.996262	6156	6053	5950	5850	171
10	6249	6144	6040	5938	5837	172
20	6237	6132	6028	5925	5824	172
30	6226	6120	6015	5912	5811	173
40	6214	6108	6002	5900	5798	173
50	6202	6096	5991	5887	5785	174
58 0	9.996190	6084	5978	5874	5772	174
10	6178	6072	5966	5861	5759	175
20	6166	6060	5953	5849	5746	175
30	6155	6047	5941	5836	5733	176
40	6143	6035	5929	5823	5720	176
50	6132	6023	5916	5811	5707	177
59 0	9.996119	6011	5904	5798	5694	177
10	6107	5999	5891	5785	5680	178
20	6096	5987	5879	5772	5667	178
30	6084	5975	5866	5760	5654	179
40	6072	5962	5854	5747	5641	179
50	6060	5950	5842	5734	5628	180
60 0	9.996048	5938	5829	5721	5615	180
10	6037	5926	5817	5708	5602	181
20	6025	5914	5804	5695	5589	181
30	6013	5902	5792	5683	5576	182
40	6001	5890	5779	5671	5563	182
50	5989	5878	5767	5658	5550	183
61 0	9.995978	5866	5755	5645	5537	183
10	5966	5853	5742	5632	5524	184
20	5954	5841	5730	5620	5511	184
30	5943	5829	5717	5607	5498	185
40	5931	5817	5705	5594	5485	186
50	5919	5805	5693	5582	5472	187
62 0	9.995907	5793	5680	5569	5459	187

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	1	3	4	5	6	7	9	10	11	

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	38°	39°	40°	41°	42°	
53′ 0″	9.996069	5977	5887	5798	5711	149
10	6056	5964	5873	5784	5697	150
20	6042	5950	5859	5770	5682	150
30	6029	5937	5846	5756	5668	151
40	6016	5923	5832	5741	5653	152
50	6003	5910	5818	5727	5639	152
54 0	9.995989	5896	5804	5713	5624	153
10	5976	5883	5790	5699	5610	153
20	5963	5869	5776	5685	5596	154
30	5950	5856	5762	5671	5581	154
40	5936	5842	5748	5657	5567	155
50	5923	5829	5735	5643	5552	155
55 0	9.995910	5815	5721	5628	5538	156
10	5896	5801	5707	5614	5523	156
20	5883	5788	5693	5600	5509	157
30	5870	5774	5679	5586	5494	157
40	5856	5761	5665	5572	5480	158
50	5843	5747	5652	5558	5465	158
56 0	9.995830	5733	5637	5544	5451	158
10	5816	5720	5623	5529	5437	159
20	5803	5706	5609	5515	5422	159
30	5790	5693	5596	5501	5408	160
40	5776	5679	5582	5487	5394	160
50	5763	5666	5568	5473	5379	161
57 0	9.995750	5652	5554	5459	5365	161
10	5736	5638	5541	5444	5350	162
20	5723	5625	5527	5430	5336	162
30	5710	5611	5513	5416	5321	162
40	5696	5597	5499	5402	5307	163
50	5683	5584	5485	5388	5292	163
58 0	9.995670	5570	5471	5374	5278	164
10	5656	5556	5457	5359	5263	164
20	5643	5543	5443	5345	5249	165
30	5630	5529	5429	5331	5234	165
40	5616	5516	5416	5317	5220	166
50	5603	5502	5402	5303	5205	166
59 0	9.995590	5488	5388	5289	5191	167
10	5576	5475	5374	5274	5177	167
20	5563	5461	5360	5260	5163	167
30	5550	5447	5346	5246	5148	168
40	5536	5434	5332	5232	5134	168
50	5523	5420	5318	5218	5119	168
60 0	9.995510	5407	5304	5204	5105	169
10	5496	5393	5291	5189	5090	169
20	5483	5379	5277	5175	5076	170
30	5470	5366	5263	5161	5061	170
40	5456	5352	5249	5147	5047	171
50	5443	5338	5235	5133	5032	171
61 0	9.995430	5325	5221	5119	5018	172
10	5416	5311	5207	5104	5003	172
20	5403	5297	5193	5090	4989	173
30	5390	5284	5180	5076	4974	173
40	5376	5270	5166	5062	4960	174
50	5363	5256	5152	5048	4945	174
62 0	9.995350	5243	5138	5033	4931	175

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	1	3	4	6	7	8	10	11	13	

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	43°	44°	45°	46°	47°	
53′ 0″	9.995625	5540	5456	5374	5294	138
10	5610	5525	5441	5359	5279	138
20	5595	5510	5426	5344	5263	138
30	5581	5495	5410	5328	5247	139
40	5566	5480	5395	5313	5231	139
50	5551	5465	5380	5298	5216	139
54 0	9.995536	5450	5365	5282	5200	140
10	5522	5435	5350	5267	5184	140
20	5507	5420	5334	5251	5168	141
30	5492	5405	5319	5236	5153	141
40	5478	5390	5304	5220	5137	142
50	5463	5375	5289	5205	5121	142
55 0	9.995448	5360	5274	5189	5105	143
10	5434	5345	5258	5174	5089	143
20	5419	5331	5243	5158	5074	144
30	5404	5316	5228	5143	5058	144
40	5390	5301	5213	5127	5042	145
50	5375	5286	5197	5112	5026	145
56 0	9.995360	5271	5182	5096	5011	146
10	5346	5256	5167	5080	4995	146
20	5331	5241	5152	5065	4979	147
30	5316	5226	5136	5049	4964	147
40	5302	5211	5121	5034	4948	147
50	5287	5195	5106	5018	4932	148
57 0	9.995272	5181	5091	5003	4916	148
10	5258	5166	5076	4987	4901	149
20	5243	5151	5060	4972	4885	149
30	5228	5136	5045	4956	4869	150
40	5214	5121	5030	4941	4853	150
50	5199	5106	5015	4925	4837	151
58 0	9.995184	5091	5000	4910	4822	151
10	5169	5076	4984	4894	4806	152
20	5155	5061	4969	4879	4790	152
30	5140	5046	4954	4863	4775	152
40	5125	5031	4939	4848	4759	153
50	5110	5016	4923	4832	4743	153
59 0	9.995095	5001	4908	4817	4727	153
10	5081	4986	4893	4801	4712	154
20	5066	4971	4878	4786	4696	154
30	5051	4956	4862	4770	4680	155
40	5037	4941	4847	4755	4665	155
50	5022	4926	4832	4739	4649	156
60 0	9.995007	4911	4817	4724	4633	156
10	4993	4896	4801	4708	4617	157
20	4978	4881	4786	4693	4601	157
30	4963	4866	4771	4677	4586	157
40	4949	4851	4756	4662	4570	158
50	4934	4836	4740	4646	4554	158
61 0	9.994919	4821	4725	4631	4538	158
10	4904	4806	4710	4615	4523	159
20	4890	4791	4695	4600	4507	159
30	4875	4776	4679	4584	4491	160
40	4860	4761	4664	4569	4476	160
50	4845	4746	4649	4553	4460	161
62 0	9.994830	4731	4634	4538	4444	161

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	3	4	6	7	9	10	12	14	

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	48°	49°	50°	51°	52°	
53′ 0″	9.995215	5137	5061	4986	4913	126
10	5199	5121	5045	4969	4896	126
20	5183	5105	5028	4952	4880	127
30	5167	5089	5012	4936	4862	127
40	5151	5072	4995	4919	4846	127
50	5135	5056	4979	4902	4829	128
54 0	9.995119	5040	4962	4886	4812	128
10	5103	5024	4946	4869	4795	128
20	5087	5008	4930	4852	4778	129
30	5071	4991	4913	4836	4761	129
40	5055	4975	4897	4819	4744	130
50	5039	4959	4880	4802	4727	130
55 0	9.995023	4943	4864	4786	4710	131
10	5007	4926	4847	4769	4693	131
20	4991	4910	4831	4752	4676	131
30	4975	4894	4814	4736	4660	132
40	4959	4878	4798	4719	4643	132
50	4943	4861	4781	4702	4626	132
56 0	9.994927	4845	4765	4686	4609	133
10	4911	4829	4748	4669	4592	133
20	4895	4813	4732	4652	4575	133
30	4879	4796	4715	4636	4558	134
40	4863	4780	4699	4619	4541	134
50	4847	4764	4682	4602	4524	135
57 0	9.994831	4748	4666	4586	4507	135
10	4815	4731	4649	4569	4490	136
20	4799	4715	4633	4552	4473	136
30	4783	4699	4616	4536	4457	136
40	4767	4683	4600	4519	4440	137
50	4751	4666	4583	4502	4423	137
58 0	9.994735	4650	4567	4486	4406	137
10	4719	4634	4550	4469	4389	138
20	4703	4618	4534	4452	4372	138
30	4687	4601	4517	4436	4355	138
40	4671	4585	4501	4419	4338	139
50	4655	4569	4484	4402	4321	139
59 0	9.994639	4553	4468	4385	4304	140
10	4623	4536	4451	4369	4287	140
20	4607	4520	4435	4352	4270	141
30	4591	4504	4418	4335	4253	141
40	4575	4488	4402	4319	4236	142
50	4559	4472	4385	4302	4220	142
60 0	9.994543	4455	4369	4285	4203	142
10	4527	4439	4352	4269	4186	143
20	4511	4423	4336	4252	4169	143
30	4495	4407	4319	4235	4152	143
40	4479	4390	4303	4219	4135	144
50	4463	4374	4286	4202	4118	144
61 0	9.994447	4358	4270	4185	4101	145
10	4431	4342	4253	4168	4084	145
20	4415	4325	4237	4152	4067	145
30	4399	4309	4220	4135	4050	146
40	4383	4293	4204	4118	4033	146
50	4367	4277	4188	4101	4016	147
62 0	9.994351	4260	4171	4084	3999	147

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	3	5	7	8	10	12	13	15	

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	53°	54°	55°	56°	57°	
53′ 0″	9.994842	4773	4705	4639	4574	112
10	4825	4756	4687	4621	4556	112
20	4808	4738	4670	4603	4538	112
30	4791	4721	4652	4586	4520	113
40	4774	4703	4635	4568	4502	113
50	4757	4686	4617	4550	4484	113
54 0	9.994739	4668	4599	4532	4466	114
10	4722	4651	4582	4514	4448	114
20	4705	4634	4564	4496	4430	114
30	4688	4617	4547	4479	4412	115
40	4671	4599	4529	4461	4394	115
50	4654	4582	4512	4443	4376	115
55 0	9.994637	4564	4494	4425	4358	116
10	4620	4547	4476	4408	4340	116
20	4602	4530	4459	4390	4322	117
30	4585	4512	4441	4372	4304	117
40	4568	4495	4423	4354	4286	117
50	4551	4478	4406	4337	4268	118
56 0	9.994534	4460	4388	4319	4250	118
10	4516	4443	4371	4301	4232	118
20	4499	4425	4353	4283	4214	119
30	4482	4408	4336	4265	4196	119
40	4465	4391	4318	4247	4180	120
50	4448	4373	4301	4230	4160	120
57 0	9.994431	4356	4283	4212	4142	121
10	4414	4339	4265	4194	4124	121
20	4397	4321	4248	4176	4106	121
30	4379	4304	4230	4158	4099	122
40	4362	4287	4213	4140	4070	122
50	4345	4269	4195	4123	4052	122
58 0	9.994328	4252	4178	4105	4034	123
10	4311	4234	4160	4087	4016	123
20	4294	4217	4142	4069	3998	123
30	4276	4200	4125	4051	3980	124
40	4259	4182	4107	4033	3962	124
50	4242	4165	4090	4016	3944	124
59 0	9.994225	4147	4072	3998	3926	125
10	4208	4130	4054	3980	3908	125
20	4191	4112	4037	3962	3890	125
30	4174	4095	4019	3944	3872	126
40	4156	4078	4002	3927	3854	126
50	4139	4061	3984	3909	3836	127
60 0	9.994122	4043	3967	3891	3818	127
10	4105	4026	3949	3873	3800	127
20	4088	4008	3931	3855	3782	128
30	4071	3991	3913	3837	3764	128
40	4054	3974	3896	3820	3746	128
50	4036	3957	3879	3802	3728	129
61 0	9.994019	3939	3860	3785	3710	129
10	4002	3921	3843	3766	3692	129
20	3985	3904	3825	3748	3674	130
30	3968	3886	3808	3731	3656	130
40	3951	3869	3790	3713	3638	130
50	3933	3851	3773	3695	3620	131
62 0	9.993916	3834	3755	3677	3602	131

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	3	5	7	9	11	13	14	16	

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	58°	59°	60°	61°	62°	
53′ 0″	9.994512	4451	4392	4335	4279	96
10	4494	4432	4374	4316	4260	97
20	4476	4414	4355	4297	4241	97
30	4458	4396	4337	4279	4222	97
40	4439	4377	4318	4260	4203	98
50	4421	4359	4300	4241	4184	98
54 0	9.994403	4341	4281	4222	4165	98
10	4385	4322	4263	4204	4146	99
20	4366	4304	4244	4185	4127	99
30	4348	4285	4225	4166	4109	99
40	4330	4267	4207	4147	4090	100
50	4312	4249	4188	4129	4071	100
55 0	9.994294	4230	4169	4110	4052	101
10	4275	4212	4151	4091	4033	101
20	4257	4194	4132	4072	4014	101
30	4239	4175	4114	4054	3995	102
40	4221	4157	4095	4035	3976	102
50	4203	4139	4077	4016	3957	102
56 0	9.994184	4120	4058	3997	3938	103
10	4166	4102	4039	3978	3919	103
20	4148	4083	4021	3959	3900	103
30	4130	4065	4002	3940	3882	104
40	4112	4046	3984	3922	3863	104
50	4093	4028	3965	3903	3844	104
57 0	9.994075	4009	3946	3885	3825	104
10	4057	3991	3928	3866	3806	105
20	4039	3973	3909	3847	3787	105
30	4021	3954	3891	3828	3768	105
40	4002	3936	3872	3810	3749	106
50	3984	3918	3854	3791	3730	106
58 0	9.993966	3899	3835	3772	3711	106
10	3948	3881	3816	3753	3692	107
20	3930	3863	3798	3735	3673	107
30	3911	3844	3779	3716	3654	107
40	3893	3826	3759	3697	3635	107
50	3875	3808	3742	3678	3616	108
59 0	9.993857	3789	3723	3660	3597	108
10	3839	3771	3705	3641	3579	108
20	3820	3753	3686	3622	3560	109
30	3802	3734	3668	3603	3541	109
40	3784	3716	3649	3584	3522	109
50	3766	3697	3630	3566	3503	110
60 0	9.993748	3679	3612	3547	3484	110
10	3729	3660	3593	3528	3465	110
20	3711	3642	3574	3509	3446	111
30	3693	3623	3556	3490	3427	111
40	3675	3605	3537	3472	3408	111
50	3657	3587	3518	3453	3389	112
61 0	9.993638	3568	3500	3434	3370	112
10	3620	3550	3481	3415	3351	112
20	3602	3532	3462	3396	3332	113
30	3584	3513	3444	3378	3313	113
40	3566	3495	3425	3359	3294	113
50	3548	3477	3406	3340	3275	114
62 0	9.993529	3458	3388	3321	3256	114

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	4	6	7	9	11	13	15	17	

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center. 63°	64°	65°	66°	67°	Diff. to 100′
53′ 0″	9.994224	4172	4121	4073	4027	82
10	4205	4153	4102	4053	4007	82
20	4186	4134	4083	4034	3987	83
30	4167	4114	4063	4014	3968	83
40	4148	4095	4044	3995	3948	83
50	4129	4076	4025	3975	3928	84
54 0	9.994110	4057	4005	3956	3908	84
10	4091	4038	3986	3936	3889	84
20	4072	4018	3966	3917	3869	85
30	4053	3999	3947	3897	3849	85
40	4034	3980	3927	3877	3830	85
50	4015	3961	3908	3858	3810	86
55 0	9.993996	3941	3888	3838	3790	86
10	3977	3922	3869	3819	3770	86
20	3957	3903	3850	3799	3751	86
30	3938	3884	3830	3780	3731	87
40	3919	3864	3811	3760	3711	87
50	3900	3845	3791	3740	3692	87
56 0	9.993881	3826	3772	3721	3672	87
10	3862	3807	3753	3701	3652	88
20	3843	3787	3733	3682	3632	88
30	3824	3768	3714	3662	3613	88
40	3805	3749	3695	3642	3592	88
50	3786	3730	3675	3623	3573	89
57 0	9.993766	3710	3656	3603	3553	89
10	3747	3691	3636	3584	3534	89
20	3728	3672	3617	3564	3514	89
30	3709	3652	3598	3545	3494	90
40	3690	3633	3578	3525	3474	90
50	3671	3614	3559	3505	3455	90
58 0	9.993652	3594	3539	3486	3435	91
10	3632	3575	3520	3466	3415	91
20	3613	3556	3500	3447	3396	91
30	3594	3537	3481	3427	3376	91
40	3575	3517	3461	3407	3356	92
50	3556	3498	3442	3388	3336	92
59 0	9.993537	3479	3422	3368	3317	92
10	3518	3459	3403	3349	3297	92
20	3498	3440	3384	3329	3277	93
30	3479	3421	3364	3310	3258	93
40	3460	3402	3345	3290	3238	93
50	3441	3382	3325	3270	3218	93
60 0	9.993421	3363	3306	3251	3198	94
10	3402	3344	3286	3231	3179	94
20	3383	3324	3267	3212	3159	94
30	3364	3305	3248	3192	3139	94
40	3345	3286	3228	3172	3119	95
50	3326	3267	3209	3153	3100	95
61 0	9.993307	3247	3189	3133	3080	95
10	3288	3228	3170	3114	3060	95
20	3269	3209	3150	3094	3040	96
30	3249	3189	3131	3075	3021	96
40	3230	3170	3111	3055	3001	96
50	3211	3150	3092	3035	2981	97
62 0	9.993192	3131	3072	3015	2961	97

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	2	4	6	8	10	12	14	16	18	Sub.

Moon's Hor. Par.	App. Alt. Moon's Center. 68°	69°	70°	71°	72°	Diff. to 100′
53′ 0″	9.993982	3939	3898	3858	3822	67
10	3962	3919	3878	3838	3802	67
20	3942	3899	3858	3817	3781	67
30	3922	3879	3838	3797	3761	67
40	3902	3859	3818	3777	3740	67
50	3882	3839	3798	3757	3720	67
54 0	9.993863	3818	3777	3737	3699	68
10	3843	3798	3757	3716	3679	68
20	3823	3778	3737	3696	3658	68
30	3803	3758	3717	3676	3638	68
40	3783	3738	3697	3656	3617	68
50	3763	3718	3677	3636	3597	68
55 0	9.993743	3698	3656	3615	3576	69
10	3724	3678	3636	3595	3556	69
20	3704	3658	3616	3575	3536	69
30	3684	3638	3596	3555	3515	69
40	3664	3618	3576	3535	3495	69
50	3614	3598	3556	3514	3475	70
56 0	9.993624	3578	3535	3494	3455	70
10	3604	3558	3515	3474	3434	70
20	3585	3538	3495	3454	3414	70
30	3565	3518	3475	3434	3394	70
40	3545	3498	3455	3413	3373	71
50	3525	3478	3435	3393	3353	71
57 0	9.993505	3458	3415	3373	3333	71
10	3485	3438	3394	3353	3312	71
20	3466	3418	3374	3332	3292	71
30	3446	3398	3354	3312	3272	72
40	3426	3378	3334	3292	3251	72
50	3406	3358	3314	3272	3231	72
58 0	9.993386	3338	3294	3251	3211	72
10	3366	3318	3273	3231	3190	72
20	3346	3298	3253	3211	3170	73
30	3326	3278	3233	3191	3149	73
40	3306	3258	3213	3170	3129	73
50	3286	3238	3193	3150	3108	73
59 0	9.993267	3218	3173	3130	3088	73
10	3247	3198	3152	3110	3068	74
20	3227	3178	3132	3089	3047	74
30	3207	3158	3112	3069	3027	74
40	3187	3138	3092	3049	3907	74
50	3167	3118	3072	3029	2986	75
60 0	9.993147	3098	3052	3008	2966	75
10	3127	3078	3031	2988	2946	75
20	3108	3058	3011	2968	2925	75
30	3088	3038	2991	2948	2905	76
40	3068	3018	2971	2927	2885	76
50	3048	2998	2951	2907	2864	76
61 0	9.993028	2978	2931	2887	2844	76
10	3008	2958	2910	2867	2824	76
20	2988	2938	2890	2846	2803	77
30	2968	2918	2870	2826	2783	77
40	2948	2898	2850	2806	2762	77
50	2928	2878	2830	2786	2742	77
62 0	9.992909	2858	2810	2765	2722	77

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	
	2	4	6	8	10	12	14	16	18	Sub.

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	73°	74°	75°	76°	77°	
53′ 0″	9.993788	3753	3721	3691	3664	52
10	3767	3732	3700	3670	3643	52
20	3746	3712	3680	3649	3623	52
30	3726	3691	3659	3629	3602	52
40	3705	3671	3636	3608	3581	52
50	3684	3650	3617	3587	3560	52
54 0	9.993664	3630	3597	3567	3540	52
10	3643	3609	3576	3546	3519	52
20	3623	3588	3555	3525	3498	52
30	3602	3568	3536	3505	3477	53
40	3582	3547	3514	3484	3456	53
50	3561	3526	3493	3463	3436	53
55 0	9.993541	3506	3473	3443	3415	53
10	3520	3485	3452	3422	3394	53
20	3500	3464	3431	3401	3373	53
30	3479	3444	3411	3380	3352	53
40	3459	3423	3390	3360	3331	54
50	3438	3402	3370	3339	3310	54
56 0	9.993418	3382	3349	3318	3289	54
10	3397	3361	3328	3297	3269	54
20	3377	3340	3307	3276	3248	54
30	3356	3320	3287	3255	3227	54
40	3336	3299	3266	3234	3206	54
50	3315	3278	3245	3214	3185	55
57 0	9.993295	3258	3225	3193	3164	55
10	3274	3237	3204	3172	3144	55
20	3254	3217	3183	3151	3123	55
30	3233	3196	3163	3131	3102	55
40	3213	3176	3142	3110	3081	55
50	3192	3155	3121	3089	3060	56
58 0	9.993172	3136	3101	3068	3039	56
10	3151	3114	3080	3047	3018	56
20	3131	3094	3060	3027	2997	56
30	3110	3073	3039	3006	2977	56
40	3090	3053	3018	2985	2956	56
50	3069	3032	2997	2964	2935	56
59 0	9.993049	3012	2977	2944	2914	57
10	3028	2991	2956	2923	2893	57
20	3008	2970	2935	2902	2872	57
30	2987	2950	2915	2881	2851	57
40	2967	2929	2894	2860	2830	57
50	2946	2908	2873	2840	2809	57
60 0	9.992926	2888	2853	2819	2788	58
10	2905	2867	2832	2798	2768	58
20	2885	2847	2811	2777	2747	58
30	2864	2826	2791	2756	2726	58
40	2844	2806	2770	2736	2705	58
50	2823	2785	2749	2715	2684	58
61 0	9.992803	2765	2729	2694	2663	58
10	2782	2744	2708	2673	2642	59
20	2762	2723	2687	2653	2621	59
30	2741	2703	2666	2632	2600	59
40	2721	2682	2645	2611	2580	59
50	2700	2661	2626	2590	2559	59
62 0	9.992680	2641	2604	2570	2538	59

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	4	6	8	11	13	15	17	19	

Moon's Hor. Par.	App. Alt. Moon's Center.					Diff. to 100′
	78°	79°	80°	81°	82°	
53′ 0″	9.993640	3617	3595	3577	3560	33
10	3619	3596	3574	3556	3539	33
20	3598	3575	3553	3535	3518	33
30	3577	3554	3532	3513	3496	34
40	3556	3533	3511	3492	3475	34
50	3535	3512	3490	3471	3454	34
54 0	9.993514	3491	3469	3450	3433	34
10	3493	3470	3448	3429	3412	34
20	3472	3449	3427	3408	3390	34
30	3451	3428	3406	3387	3369	34
40	3430	3407	3385	3365	3348	35
50	3409	3386	3364	3344	3327	35
55 0	9.993388	3365	3343	3323	3306	35
10	3368	3344	3322	3302	3284	35
20	3347	3323	3301	3281	3263	35
30	3326	3302	3280	3260	3242	35
40	3305	3281	3259	3238	3221	35
50	3284	3260	3238	3217	3200	35
56 0	9.993263	3239	3217	3196	3178	36
10	3242	3218	3196	3175	3157	36
20	3221	3197	3175	3154	3136	36
30	3200	3176	3154	3133	3115	36
40	3179	3155	3133	3111	3094	36
50	3158	3134	3111	3090	3072	36
57 0	9.993137	3113	3090	3069	3051	36
10	3117	3092	3069	3048	3030	36
20	3096	3071	3048	3027	3009	36
30	3075	3050	3027	3006	2988	36
40	3054	3029	3006	2985	2966	37
50	3033	3008	2985	2964	2945	37
58 0	0.993012	2987	2964	2943	2924	37
10	2991	2966	2943	2921	2903	37
20	2970	2945	2922	2900	2881	37
30	2949	2924	2901	2879	2860	37
40	2928	2902	2880	2858	2839	37
50	2907	2881	2858	2837	2818	37
59 0	9.992886	2860	2837	2816	2797	37
10	2865	2839	2816	2795	2775	37
20	2844	2818	2795	2773	2754	37
30	2823	2797	2774	2752	2733	37
40	2802	2776	2752	2731	2712	38
50	2781	2755	2731	2710	2691	38
60 0	9.992760	2734	2710	2689	2669	38
10	2739	2713	2689	2668	2648	38
20	2718	2692	2668	2647	2627	38
30	2697	2671	2647	2626	2606	38
40	2676	2650	2626	2604	2585	38
50	2655	2629	2605	2563	2563	38
61 0	9.992634	2608	2584	2562	2542	38
10	2614	2587	2563	2541	2521	38
20	2593	2566	2542	2520	2500	38
30	2572	2545	2520	2499	2479	38
40	2551	2524	2409	2478	2457	38
50	2530	2503	2478	2456	2436	39
62 0	9.992509	2482	2457	2435	2415	39

P. parts to sec. of par.	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
	2	4	6	8	11	13	15	17	19	

TABLE XXXIX.

LOGARITHMIC DIFFERENCE.

Moon's Hor. Par.	App. Alt. Moon's Center.				Diff. to 100′	Moon's Hor. Par.	App. Alt. ☽'s Center.		
	83°	84°	85°	86°			87°	88°	89°
53′ 0″	9.993545	3532	3521	3512	18	53′ 0″	9.993505	3499	3497
10	3523	3511	3500	3491	18	10	3483	3477	3475
20	3502	3489	3478	3469	18	20	3462	3456	3454
30	3481	3468	3457	3448	18	30	3441	3435	3432
40	3460	3447	3436	3427	18	40	3419	3413	3410
50	3439	3426	3415	3405	18	50	3398	3392	3389
54 0	9.993418	3405	3393	3384	18	54 0	9.993377	3371	3368
10	3397	3383	3372	3362	18	10	3355	3349	3346
20	3375	3362	3351	3341	18	20	3334	3328	3325
30	3354	3341	3329	3319	18	30	3313	3306	3303
40	3333	3320	3308	3298	18	40	3291	3285	3282
50	3312	3298	3287	3277	18	50	3270	3264	3261
55 0	9.993290	3277	3265	3255	18	55 0	9.993248	3242	3239
10	3269	3256	3244	3234	18	10	3227	3221	3218
20	3247	3234	3223	3213	18	20	3205	3199	3197
30	3226	3213	3201	3191	18	30	3184	3178	3175
40	3205	3192	3180	3170	18	40	3163	3156	3154
50	3184	3171	3159	3149	18	50	3141	3135	3132
56 0	9.993162	3149	3137	3127	19	56 0	9.993120	3114	3111
10	3141	3128	3116	3106	19	10	3098	3092	3090
20	3120	3106	3095	3085	19	20	3077	3071	3068
30	3098	3086	3073	3063	19	30	3056	3049	3047
40	3077	3064	3052	3042	19	40	3034	3028	3025
50	3056	3042	3031	3021	19	50	3013	3007	3004
57 0	9.993035	3021	3009	2999	19	57 0	9.992991	2985	2982
10	3013	2999	2988	2976	19	10	2970	2964	2961
20	2992	2978	2967	2957	19	20	2949	2943	2940
30	2971	2957	2946	2935	19	30	2927	2921	2918
40	2950	2936	2924	2914	19	40	2906	2900	2897
50	2928	2914	2903	2893	19	50	2885	2879	2876
58 0	9.992907	2893	2881	2871	19	58 0	9.992863	2857	2854
10	2886	2871	2860	2850	19	10	2842	2836	2833
20	2865	2850	2839	2829	19	20	2821	2814	2812
30	2843	2829	2817	2807	19	30	2799	2793	2791
40	2822	2807	2796	2786	19	40	2778	2771	2769
50	2801	2786	2775	2765	19	50	2757	2750	2748
59 0	9.992780	2765	2753	2743	19	59 0	9.992735	2729	2726
10	2758	2744	2732	2722	19	10	2714	2707	2705
20	2737	2722	2710	2771	19	20	2693	2686	2683
30	2716	2701	2690	2679	19	30	2671	2664	2662
40	2695	2680	2668	2658	19	40	2650	2643	2640
50	2673	2659	2647	2637	19	50	2629	2622	2619
60 0	9.992652	2638	2625	2615	19	60 0	9.992607	2600	2597
10	2631	2616	2604	2594	19	10	2586	2579	2576
20	2610	2595	2583	2573	19	20	2565	2558	2555
30	2588	2574	2561	2551	19	30	2543	2537	2533
40	2567	2552	2540	2530	19	40	2522	2515	2512
50	2546	2531	2519	2508	19	50	2501	2494	2490
61 0	9.992525	2510	2497	2487	19	61 0	9.992479	2472	2469
10	2503	2488	2476	2465	19	10	2458	2451	2448
20	2482	2467	2455	2444	19	20	2436	2430	2426
30	2461	2446	2433	2423	19	30	2415	2408	2405
40	2440	2424	2412	2401	19	40	2393	2387	2383
50	2418	2403	2391	2380	19	50	2372	2366	2362
62 0	9.992397	2382	2369	2358	19	62 0	9.992350	2344	2340

P. parts to	1″	2″	3″	4″	5″	6″	7″	8″	9″	Sub.
sec. of par.	2	4	6	9	11	13	15	17	19	

TABLE XL.

Correction of the Logarithmic Diff. when the Sun is observed.

App. Alt. Sun.	Cor. Sub.	App. Alt. Sun.	Cor. Sub.
°		°	
3	28	44	13
4	19	46	14
5	14	48	14
6	11	49	14
7	9	50	15
8	8	52	15
9	7	54	15
10	7	55	16
12	6	56	16
14	6	58	16
16	7	60	16
18	7	62	16
20	8	63	17
21	8	64	17
22	8	66	17
24	8	68	17
25	8	69	18
26	9	70	18
28	9	72	18
29	10	74	18
30	10	76	18
32	10	78	18
33	11	79	18
34	11	80	18
36	11	81	18
37	12	82	18
38	12	84	19
40	12	86	19
41	13	88	19
42	13	90	19

TABLE XLI.

Correction of the Logarithmic Diff. when a Star is observed.

App. Alt. Star.	Cor. Sub.	App. Alt. Star.	Cor. Sub.
°		°	
3	27	23	1
4	19	24	1
5	12	25	1
6	9	26	1
7	7	27	1
8	6	28	1
9	5	29	1
10	4	30	0
11	3	31	0
12	3	32	0
13	2	33	0
14	2	34	0
15	1	35	0
16	1	36	0
17	1	37	0
18	1	38	0
19	1	39	0
20	1	40	0
21	1	to	
22	1	90	0

TABLE XLII.

AMPLITUDES.

	DECLINATION.																											
Lat.	1°		2°		3°		4°		5°		6°		7°		8°		9°		10°		11°		12°		13°		14°	
°	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′
1	1	0	2	0	3	0	4	0	5	0	6	0	7	0	8	0	9	0	10	0	11	0	12	0	13	0	14	0
3	1	0	2	0	3	0	4	0	5	0	6	0	7	1	8	1	9	1	10	1	11	1	12	1	13	1	14	1
5	1	0	2	0	3	1	4	1	5	1	6	1	7	2	8	2	9	2	10	2	11	3	12	3	13	3	14	3
7	1	0	2	1	3	1	4	2	5	2	6	3	7	3	8	4	9	4	10	5	11	5	12	5	13	6	14	6
9	1	1	2	1	3	2	4	3	5	4	6	5	7	5	8	6	9	7	10	8	11	8	12	9	13	10	14	11
10	1	1	2	2	3	3	4	4	5	5	6	6	7	6	8	8	9	9	10	10	11	11	12	11	13	12	14	13
11	1	1	2	2	3	3	4	4	5	6	6	7	7	7	8	9	9	10	10	11	11	13	12	13	13	15	14	16
12	1	1	2	3	3	4	4	5	5	7	6	8	7	9	8	11	9	12	10	13	11	15	12	16	13	18	14	19
13	1	2	2	3	3	5	4	6	5	8	6	10	7	11	8	13	9	14	10	16	11	18	12	19	13	21	14	23
14	1	2	2	4	3	6	4	7	5	9	6	11	7	13	8	15	9	17	10	19	11	20	12	22	13	24	14	26
15	1	2	2	4	3	6	4	8	5	11	6	13	7	15	8	17	9	19	10	21	11	24	12	26	13	28	14	30
16	1	2	2	5	3	7	4	10	5	12	6	15	7	17	8	19	9	22	10	24	11	27	12	29	13	32	14	35
17	1	3	2	5	3	8	4	11	5	14	6	17	7	19	8	22	9	25	10	28	11	31	12	33	13	36	14	39
18	1	3	2	6	3	9	4	12	5	15	6	19	7	22	8	25	9	28	10	31	11	34	12	38	13	41	14	44
19	1	3	2	7	3	10	4	14	5	17	6	21	7	24	8	28	9	31	10	35	11	39	12	42	13	46	14	49
20	1	4	2	8	3	12	4	15	5	19	6	23	7	27	8	31	9	35	10	39	11	43	12	47	13	51	14	55
21	1	4	2	9	3	13	4	17	5	21	6	26	7	30	8	34	9	39	10	43	11	48	12	52	13	57	15	1
22	1	5	2	9	3	14	4	19	5	24	6	28	7	33	8	38	9	43	10	48	11	53	12	57	14	2	15	7
23	1	5	2	10	3	16	4	21	5	26	6	31	7	36	8	42	9	47	10	52	11	58	13	3	14	9	15	14
24	1	6	2	11	3	17	4	23	5	28	6	34	7	40	8	46	9	52	10	57	12	3	13	9	14	15	15	21
25	1	6	2	12	3	19	4	25	5	31	6	37	7	44	8	50	9	56	11	3	12	9	13	16	14	22	15	29
26	1	7	2	14	3	20	4	27	5	34	6	41	7	48	8	54	10	1	11	8	12	15	13	22	14	30	15	37
27	1	7	2	15	3	22	4	29	5	37	6	44	7	52	8	59	10	7	11	14	12	22	13	30	14	37	15	45
28	1	8	2	16	3	24	4	32	5	40	6	48	7	56	9	4	10	12	11	21	12	29	13	37	14	46	15	54
29	1	9	2	17	3	26	4	34	5	43	6	52	8	1	9	9	10	18	11	27	12	36	13	45	14	54	16	3
30	1	9	2	19	3	28	4	37	5	47	6	56	8	5	9	15	10	24	11	34	12	44	13	53	15	3	16	13
31	1	10	2	20	3	30	4	40	5	50	7	0	8	10	9	21	10	31	11	41	12	52	14	2	15	13	16	24
32	1	11	2	22	3	32	4	43	5	54	7	5	8	16	9	27	10	38	11	49	13	0	14	11	15	23	16	34
33	1	12	2	23	3	35	4	46	5	58	7	10	8	21	9	33	10	45	11	57	13	9	14	21	15	34	16	46
34	1	12	2	25	3	37	4	50	6	2	7	15	8	27	9	40	10	53	12	5	13	18	14	31	15	45	16	58
35	1	13	2	27	3	40	4	53	6	6	7	20	8	33	9	47	11	1	12	14	13	28	14	42	15	56	17	11
36	1	14	2	28	3	43	4	57	6	11	7	25	8	40	9	54	11	9	12	24	13	39	14	54	16	9	17	24
37	1	15	2	30	3	45	5	1	6	16	7	31	8	47	10	2	11	18	12	33	13	49	15	5	16	22	17	38
38	1	16	2	32	3	48	5	5	6	21	7	37	8	54	10	10	11	27	12	44	14	1	15	18	16	35	17	53
39	1	17	2	34	3	52	5	9	6	26	7	44	9	1	10	19	11	37	12	55	14	13	15	31	16	50	18	8
40	1	18	2	37	3	55	5	13	6	32	7	51	9	9	10	28	11	47	13	6	14	25	15	45	17	5	18	25
41	1	20	2	39	3	59	5	18	6	38	7	58	9	18	10	38	11	58	13	18	14	39	15	59	17	20	18	42
42	1	21	2	42	4	2	5	23	6	44	8	5	9	26	10	48	12	9	13	31	14	53	16	15	17	37	19	0
43	1	22	2	44	4	6	5	28	6	51	8	13	9	36	10	58	12	21	13	44	15	7	16	31	17	55	19	19
44	1	23	2	47	4	10	5	34	6	58	8	21	9	45	11	9	12	34	13	58	15	23	16	48	18	13	19	39
45	1	25	2	50	4	15	5	40	7	5	8	30	9	55	11	21	12	47	14	13	15	39	17	6	18	33	20	0
46	1	26	2	53	4	19	5	46	7	12	8	39	10	6	11	33	13	1	14	29	15	57	17	25	18	54	20	23
47	1	28	2	56	4	24	5	52	7	21	8	49	10	18	11	46	13	16	14	45	16	15	17	45	19	16	20	47
48	1	30	2	59	4	29	5	59	7	29	8	59	10	30	12	0	13	31	15	2	16	34	18	6	19	39	21	12
49	1	31	3	3	4	35	6	6	7	38	9	10	10	42	12	15	13	48	15	21	16	54	18	29	20	3	21	38
50	1	33	3	7	4	40	6	14	7	48	9	22	10	56	12	30	14	5	15	40	17	16	18	52	20	29	22	7
51	1	35	3	11	4	46	6	22	7	58	9	34	11	10	12	47	14	24	16	1	17	39	19	17	20	57	22	36
52	1	37	3	15	4	53	6	30	8	8	9	47	11	25	13	4	14	43	16	23	18	3	19	44	21	26	23	8
53	1	40	3	19	4	59	6	39	8	20	10	0	11	41	13	22	15	4	16	46	18	29	20	13	21	57	23	42
54	1	42	3	24	5	7	6	49	8	32	10	15	11	58	13	42	15	26	17	11	18	57	20	43	22	30	24	18
55	1	45	3	29	5	14	6	59	8	44	10	30	12	16	14	3	15	50	17	37	19	26	21	15	23	5	24	57
56	1	47	3	35	5	22	7	10	8	58	10	46	12	35	14	25	16	15	18	5	19	57	21	50	23	43	25	38
57	1	50	3	40	5	31	7	22	9	13	11	4	12	56	14	48	16	42	18	36	20	30	22	26	24	24	26	22
58	1	53	3	47	5	40	7	34	9	28	11	23	13	18	15	14	17	10	19	8	21	6	23	6	25	7	27	10
59	1	57	3	53	5	50	7	47	9	45	11	43	13	41	15	41	17	41	19	42	21	45	23	49	25	54	28	1
60	2	0	4	0	6	0	8	1	10	2	12	4	14	6	16	10	18	14	20	19	22	26	24	34	26	44	28	56
61	2	4	4	8	6	12	8	16	10	21	12	27	14	34	16	41	18	49	20	59	23	11	25	24	27	39	29	56
62	2	8	4	16	6	24	8	33	10	42	12	52	15	3	17	15	19	28	21	42	23	59	26	17	28	38	31	1
63	2	12	4	25	6	37	8	50	11	4	13	19	15	34	17	51	20	9	22	29	24	51	27	15	29	42	32	12
64	2	17	4	34	6	51	9	9	11	28	13	48	16	8	18	31	20	54	23	20	25	48	28	19	30	52	33	30
65	2	22	4	44	7	7	9	30	11	54	14	19	16	46	19	14	21	44	24	16	26	50	29	28	32	10	34	55
66	2	28	4	55	7	24	9	53	12	22	14	54	17	26	20	1	22	37	25	16	27	59	30	45	33	35	36	30

TABLE XLII.

AMPLITUDES

	DECLINATION.											
Lat.	15°	16°	17°	18°	19°	20°	21°	21° 30′	22°	22° 30′	23°	23° 28′
°	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′	° ′
1	15 0	16 0	17 0	18 0	19 0	20 0	21 0	21 30	22 0	22 30	23 0	23 28
3	15 1	16 1	17 1	18 2	19 2	20 2	21 2	21 32	22 2	22 32	23 2	23 30
5	15 4	16 4	17 4	18 4	19 5	20 5	21 5	21 35	22 5	22 35	23 6	23 34
7	15 7	16 7	17 8	18 8	19 9	20 9	21 10	21 40	22 10	22 41	23 11	23 39
9	15 11	16 12	17 13	18 14	19 15	20 16	21 16	21 47	22 17	22 48	23 18	23 47
10	15 14	16 15	17 16	18 17	19 18	20 19	21 20	21 51	22 21	22 52	23 23	23 51
11	15 17	16 18	17 20	18 21	19 22	20 24	21 25	21 55	22 26	22 57	23 28	23 56
12	15 21	16 22	17 23	18 25	19 26	20 28	21 30	22 0	22 31	23 2	23 33	24 1
13	15 24	16 26	17 28	18 29	19 31	20 33	21 35	22 6	22 37	23 8	23 38	24 7
14	15 28	16 30	17 32	18 34	19 36	20 38	21 40	22 11	22 43	23 14	23 45	24 14
15	15 33	16 35	17 37	18 39	19 42	20 44	21 47	22 18	22 49	23 20	23 52	24 21
16	15 37	16 40	17 42	18 45	19 48	20 51	21 53	22 25	22 56	23 28	23 59	24 28
17	15 42	16 45	17 48	18 51	19 54	20 57	22 1	22 32	23 4	23 35	24 7	24 36
18	15 47	16 51	17 54	18 58	20 1	21 5	22 8	22 40	23 12	23 44	24 15	24 45
19	15 53	16 57	18 1	19 5	20 8	21 12	22 16	22 49	23 20	23 52	24 25	24 54
20	15 59	17 3	18 8	19 12	20 16	21 21	22 25	22 57	23 30	24 2	24 34	25 4
21	16 6	17 10	18 15	19 20	20 25	21 29	22 34	23 7	23 39	24 12	24 45	25 15
22	16 13	17 18	18 23	19 28	20 33	21 39	22 44	23 17	23 50	24 23	24 55	25 26
23	16 20	17 25	18 31	19 37	20 43	21 49	22 55	23 28	24 1	24 34	25 7	25 38
24	16 27	17 34	18 40	19 46	20 53	21 59	23 6	23 39	24 13	24 46	25 19	25 51
25	16 36	17 42	18 49	19 56	21 3	22 10	23 18	23 51	24 25	24 59	25 32	26 4
26	16 44	17 52	18 59	20 7	21 14	22 22	23 30	24 4	24 38	25 12	25 46	26 18
27	16 53	18 1	19 9	20 18	21 26	22 34	23 43	24 17	24 52	25 26	26 1	26 33
28	17 3	18 11	19 20	20 29	21 38	22 47	23 57	24 31	25 6	25 41	26 16	26 49
29	17 13	18 22	19 32	20 41	21 51	23 1	24 11	24 46	25 22	25 57	26 32	27 5
30	17 23	18 34	19 44	20 54	22 5	23 16	24 27	25 2	25 38	26 13	26 49	27 23
31	17 34	18 45	19 57	21 8	22 19	23 31	24 43	25 19	25 55	26 31	27 7	27 41
32	17 46	18 58	20 10	21 22	22 35	23 47	25 0	25 36	26 13	26 49	27 26	28 0
33	17 59	19 11	20 24	21 37	22 51	24 4	25 18	25 55	26 32	27 9	27 46	28 21
34	18 11	19 25	20 39	21 53	23 7	24 22	25 37	26 14	26 52	27 29	28 7	28 42
35	18 25	19 40	20 55	22 10	23 25	24 41	25 57	26 35	27 13	27 51	28 29	29 5
36	18 39	19 53	21 11	22 27	23 44	25 1	26 18	26 56	27 35	28 14	28 53	29 30
37	18 55	20 11	21 28	22 46	24 3	25 21	26 40	27 19	27 58	28 38	29 17	29 55
38	19 10	20 28	21 47	23 5	24 24	25 43	27 3	27 43	28 23	29 3	29 44	30 21
39	19 27	20 46	22 6	23 26	24 46	26 7	27 28	28 8	28 49	29 30	30 11	30 49
40	19 45	21 5	22 26	23 47	25 9	26 31	27 54	28 35	29 17	29 58	30 40	31 19
41	20 3	21 25	22 48	24 10	25 33	26 57	28 21	29 3	29 46	30 28	31 11	31 51
42	20 23	21 46	23 10	24 34	25 59	27 24	28 50	29 33	30 16	31 0	31 43	32 24
43	20 44	22 8	23 34	25 0	26 26	27 53	29 20	30 5	30 49	31 33	32 18	32 59
44	21 5	22 32	23 59	25 26	26 55	28 23	29 53	30 38	31 23	32 8	32 54	33 37
45	21 28	22 57	24 25	25 55	27 25	28 56	30 27	31 13	31 59	32 46	33 33	34 17
46	21 53	23 23	24 53	26 25	27 57	29 30	31 3	31 51	32 38	33 26	34 14	34 59
47	22 18	23 50	25 23	26 57	28 31	30 6	31 42	32 30	33 19	34 8	34 57	35 44
48	22 45	24 20	25 55	27 30	29 7	30 44	32 23	33 13	34 3	34 53	35 44	36 31
49	23 14	24 51	26 28	28 6	29 45	31 25	33 7	33 58	34 49	35 41	36 33	37 22
50	23 45	25 24	27 3	28 44	30 26	32 9	33 53	34 46	35 39	36 32	37 26	38 17
51	24 17	25 59	27 41	29 25	31 9	32 55	34 43	35 37	36 32	37 27	38 23	39 15
52	24 52	26 36	28 21	30 8	31 56	33 45	35 36	36 32	37 29	38 26	39 24	40 18
53	25 28	27 16	29 4	30 54	32 45	34 38	36 33	37 31	38 30	39 29	40 29	41 26
54	26 7	27 58	29 50	31 43	33 38	35 35	37 34	38 34	39 36	40 37	41 40	42 39
55	26 49	28 43	30 39	32 36	34 35	36 36	38 40	39 43	40 47	41 51	42 56	43 58
56	27 34	29 32	31 31	33 33	35 36	37 42	39 51	40 57	42 4	43 11	44 20	45 24
57	28 22	30 21	32 28	34 34	36 43	38 54	41 9	42 18	43 27	44 38	45 50	46 59
58	29 14	31 21	33 29	35 40	37 54	40 12	42 33	43 45	44 59	46 14	47 30	48 43
59	30 10	32 21	34 35	36 52	39 12	41 37	44 6	45 22	46 40	47 59	49 21	50 38
60	31 10	33 27	35 47	38 10	40 38	43 10	45 47	47 8	48 31	49 56	51 24	52 47
61	32 16	34 39	37 5	39 36	42 11	44 52	47 40	49 7	50 36	52 7	53 42	55 13
62	33 27	35 57	38 31	41 10	43 54	46 46	49 46	51 19	52 56	54 36	56 20	58 1
63	34 45	37 23	40 5	42 54	45 49	48 53	52 8	53 50	55 36	57 27	59 23	61 18
64	36 11	38 58	41 50	44 49	47 58	51 17	54 50	56 44	58 43	60 48	63 2	65 17
65	37 46	40 43	43 46	46 59	50 23	54 2	57 59	60 8	62 25	64 53	67 36	70 26
66	39 31	42 40	45 57	49 27	53 10	57 14	61 46	64 18	67 4	70 12	73 52	78 15

TABLE XLIII.

SEMIDIURNAL AND SEMINOCTURNAL ARCHES,

For finding the Time of the Rising and Setting of a Celestial Object.

DECLINATION.

Lat	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°	11°	12°	13°	14°	15°	16°	Lat
°	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m	h. m	h. m.	h. m.	h. m.	h. m.	h m.	h. m.	h. m.	
1	6 00	6 00	6 00	6 00	6 00	6 00	6 00	6 01	6 01	6 01	6 01	6 01	6 01	6 01	6 01	6 01	1
3	6 00	6 00	6 00	6 01	6 01	6 01	6 01	6 02	6 02	6 02	6 02	6 02	6 03	6 03	6 03	6 03	3
5	6 00	6 01	6 01	6 01	6 02	6 02	6 02	6 03	6 03	6 04	6 04	6 04	6 05	6 05	6 05	6 06	5
7	6 00	6 01	6 01	6 02	6 02	6 03	6 03	6 04	6 04	6 05	6 05	6 06	6 06	6 07	6 08	6 08	7
9	6 01	6 01	6 02	6 02	6 03	6 04	6 04	6 05	6 06	6 06	6 07	6 08	6 08	6 09	6 10	6 10	9
10	6 01	6 01	6 02	6 03	6 04	6 04	6 05	6 06	6 06	6 07	6 08	6 09	6 09	6 10	6 11	6 12	10
11	6 01	6 02	6 02	6 03	6 04	6 05	6 05	6 06	6 07	6 08	6 09	6 09	6 10	6 11	6 12	6 13	11
12	6 01	6 02	6 03	6 03	6 04	6 05	6 06	6 07	6 08	6 09	6 09	6 10	6 11	6 12	6 13	6 14	12
13	6 01	6 02	6 03	6 04	6 05	6 06	6 06	6 07	6 08	6 09	6 10	6 11	6 12	6 13	6 14	6 15	13
14	6 01	6 02	6 03	6 04	6 05	6 06	6 07	6 08	6 09	6 1	6 11	6 12	6 13	6 14	6 15	6 16	14
15	6 01	6 02	6 03	6 04	6 05	6 06	6 08	6 09	6 10	6 11	6 12	6 13	6 14	6 15	6 16	6 18	15
16	6 01	6 02	6 03	6 05	6 06	6 07	6 08	6 09	6 10	6 12	6 13	6 14	6 15	6 16	6 18	6 19	16
17	6 01	6 02	6 04	6 05	6 06	6 07	6 09	6 10	6 11	6 12	6 14	6 15	6 16	6 17	6 19	6 20	17
18	6 01	6 03	6 04	6 05	6 07	6 08	6 09	6 10	6 12	6 13	6 14	6 16	6 17	6 19	6 20	6 21	18
19	6 01	6 03	6 04	6 06	6 07	6 08	6 10	6 11	6 13	6 14	6 15	6 17	6 18	6 20	6 21	6 23	19
20	6 01	6 03	6 04	6 06	6 07	6 09	6 10	6 12	6 13	6 15	6 16	6 18	6 19	6 21	6 22	6 24	20
21	6 02	6 03	6 05	6 06	6 08	6 09	6 11	6 12	6 14	6 16	6 17	6 19	6 20	6 22	6 24	6 25	21
22	6 02	6 03	6 05	6 06	6 08	6 10	6 11	6 13	6 15	6 16	6 18	6 20	6 21	6 23	6 25	6 27	22
23	6 02	6 03	6 05	6 07	6 09	6 10	6 12	6 14	6 15	6 17	6 19	6 21	6 22	6 24	6 26	6 28	23
24	6 02	6 04	6 05	6 07	6 09	6 11	6 13	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 27	6 29	24
25	6 02	6 04	6 06	6 07	6 09	6 11	6 13	6 15	6 17	6 19	6 21	6 23	6 25	6 27	6 29	6 31	25
26	6 02	6 04	6 06	6 08	6 10	6 12	6 14	6 16	6 18	6 20	6 22	6 24	6 26	6 28	6 30	6 32	26
27	6 02	6 04	6 06	6 08	6 10	6 12	6 14	6 16	6 19	6 21	6 23	6 25	6 27	6 29	6 31	6 34	27
28	6 02	6 04	6 06	6 09	6 11	6 13	6 15	6 17	6 19	6 22	6 24	6 26	6 28	6 30	6 33	6 35	28
29	6 02	6 04	6 07	6 09	6 11	6 13	6 16	6 18	6 20	6 22	6 25	6 27	6 29	6 32	6 34	6 37	29
30	6 02	6 05	6 07	6 09	6 12	6 14	6 16	6 19	6 21	6 23	6 26	6 28	6 31	6 33	6 36	6 38	30
31	6 02	6 05	6 07	6 10	6 12	6 14	6 17	6 19	6 22	6 24	6 27	6 29	6 32	6 34	6 37	6 40	31
32	6 02	6 05	6 08	6 10	6 13	6 15	6 18	6 20	6 23	6 25	6 28	6 31	6 33	6 36	6 39	6 41	32
33	6 03	6 05	6 08	6 10	6 13	6 16	6 18	6 21	6 24	6 26	6 29	6 32	6 34	6 37	6 40	6 43	33
34	6 03	6 05	6 08	6 11	6 14	6 16	6 19	6 22	6 25	6 27	6 30	6 33	6 36	6 39	6 42	6 45	34
35	6 03	6 06	6 08	6 11	6 14	6 17	6 20	6 23	6 25	6 28	6 31	6 34	6 37	6 40	6 43	6 46	35
36	6 03	6 06	6 09	6 12	6 15	6 18	6 20	6 23	6 26	6 29	6 32	6 36	6 39	6 42	6 45	6 48	36
37	6 03	6 06	6 09	6 12	6 15	6 18	6 21	6 24	6 27	6 31	6 34	6 37	6 40	6 43	6 47	6 50	37
38	6 03	6 06	6 09	6 13	6 16	6 19	6 22	6 25	6 28	6 32	6 35	6 38	6 42	6 45	6 48	6 52	38
39	6 03	6 06	6 10	6 13	6 16	6 20	6 23	6 26	6 29	6 33	6 36	6 40	6 43	6 47	6 50	6 54	39
40	6 03	6 07	6 10	6 13	6 17	6 20	6 24	6 27	6 31	6 34	6 38	6 41	6 45	6 48	6 52	6 56	40
41	6 03	6 07	6 10	6 14	6 17	6 21	6 25	6 28	6 32	6 35	6 39	6 43	6 46	6 50	6 54	6 58	41
42	6 04	6 07	6 11	6 14	6 18	6 22	6 25	6 29	6 33	6 37	6 40	6 44	6 48	6 52	6 56	7 00	42
43	6 04	6 07	6 11	6 15	6 19	6 22	6 26	6 30	6 34	6 38	6 42	6 46	6 50	6 54	6 58	7 02	43
44	6 04	6 08	6 12	6 15	6 19	6 23	6 27	6 31	6 35	6 39	6 43	6 47	6 52	6 56	7 00	7 04	44
45	6 04	6 08	6 12	6 16	6 20	6 24	6 28	6 32	6 36	6 41	6 45	6 49	6 53	6 58	7 02	7 07	45
46	6 04	6 08	6 12	6 17	6 21	6 25	6 29	6 33	6 38	6 42	6 46	6 51	6 55	7 00	7 04	7 09	46
47	6 04	6 09	6 13	6 17	6 22	6 26	6 30	6 35	6 39	6 44	6 48	6 53	6 57	7 02	7 07	7 12	47
48	6 04	6 09	6 13	6 18	6 22	6 27	6 31	6 36	6 41	6 45	6 50	6 55	6 59	7 04	7 09	7 14	48
49	6 05	6 09	6 14	6 18	6 23	6 28	6 32	6 37	6 42	6 47	6 52	6 57	7 02	7 07	7 12	7 17	49
50	6 05	6 10	6 14	6 19	6 24	6 29	6 34	6 39	6 44	6 49	6 54	6 59	7 04	7 09	7 14	7 20	50
51	6 05	6 10	6 15	6 20	6 25	6 30	6 35	6 40	6 45	6 50	6 56	7 01	7 06	7 12	7 17	7 23	51
52	6 05	6 10	6 15	6 21	6 26	6 31	6 36	6 41	6 47	6 52	6 58	7 03	7 09	7 14	7 20	7 26	52
53	6 05	6 11	6 16	6 21	6 27	6 32	6 38	6 43	6 49	6 54	7 00	7 06	7 11	7 17	7 23	7 29	53
54	6 06	6 11	6 17	6 22	6 28	6 33	6 39	6 45	6 50	6 56	7 02	7 08	7 14	7 20	7 27	7 33	54
55	6 06	6 11	6 17	6 23	6 29	6 35	6 40	6 46	6 52	6 58	7 04	7 11	7 17	7 23	7 30	7 37	55
56	6 06	6 12	6 18	6 24	6 30	6 36	6 42	6 48	6 54	7 01	7 07	7 13	7 20	7 27	7 34	7 41	56
57	6 06	6 12	6 19	6 25	6 31	6 37	6 44	6 50	6 56	7 03	7 10	7 16	7 23	7 30	7 37	7 45	57
58	6 06	6 13	6 19	6 26	6 32	6 39	6 45	6 52	6 59	7 06	7 12	7 20	7 27	7 34	7 42	7 49	58
59	6 07	6 13	6 20	6 27	6 33	6 40	6 47	6 54	7 01	7 08	7 16	7 23	7 30	7 38	7 46	7 54	59
60	6 07	6 14	6 21	6 28	6 35	6 42	6 49	6 56	7 04	7 11	7 19	7 26	7 34	7 42	7 51	7 59	60
61	6 07	6 14	6 22	6 29	6 36	6 44	6 51	6 59	7 06	7 14	7 22	7 30	7 38	7 47	7 56	8 05	61
62	6 08	6 15	6 23	6 30	6 38	6 46	6 53	7 01	7 09	7 17	7 26	7 34	7 43	7 52	8 01	8 11	62
63	6 08	6 16	6 24	6 32	6 40	6 48	6 56	7 04	7 12	7 21	7 30	7 39	7 48	7 57	8 07	8 17	63
64	6 08	6 16	6 25	6 33	6 41	6 50	6 58	7 07	7 16	7 25	7 34	7 43	7 53	8 03	8 13	8 24	64
65	6 09	6 17	6 26	6 34	6 43	6 52	7 01	7 10	7 19	7 29	7 39	7 48	7 59	8 09	8 20	8 32	65

TABLE XLIII.

SEMIDIURNAL AND SEMINOCTURNAL ARCHES,

For finding the Time of the Rising and Setting of a Celestial Object.

DECLINATION

Lat	17°	18°	19°	20°	21°	22°	23°	24°	25°	26°	27°	28°	29°	30°	Lat
°	h m	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h m.	h. m.	h. m.	°
1	6 01	6 01	6 01	6 01	6 02	6 02	6 02	6 02	6 02	6 02	6 02	6 02	6 02	6 02	1
3	6 04	6 04	6 04	6 04	6 05	6 05	6 05	6 05	6 06	6 06	6 06	6 06	6 07	6 07	3
5	6 06	6 07	6 07	6 07	6 08	6 08	6 09	6 09	6 09	6 10	6 10	6 11	6 11	6 12	5
7	6 09	6 09	6 10	6 10	6 11	6 11	6 12	6 13	6 13	6 14	6 14	6 15	6 16	6 16	7
9	6 11	6 12	6 13	6 13	6 14	6 15	6 15	6 16	6 17	6 18	6 19	6 19	6 20	6 21	9
10	6 12	6 13	6 14	6 15	6 16	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 22	6 23	10
11	6 14	6 14	6 15	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	11
12	6 15	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 26	6 27	6 28	12
13	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27	6 28	6 29	6 31	13
14	6 17	6 19	6 20	6 21	6 22	6 23	6 24	6 25	6 27	6 28	6 29	6 30	6 32	6 33	14
15	6 19	6 20	6 21	6 22	6 24	6 25	6 26	6 27	6 29	6 30	6 31	6 33	6 34	6 36	15
16	6 20	6 21	6 23	6 24	6 25	6 27	6 28	6 29	6 31	6 32	6 34	6 35	6 37	6 38	16
17	6 21	6 23	6 24	6 26	6 27	6 28	6 30	6 31	6 33	6 34	6 36	6 37	6 39	6 41	17
18	6 23	6 24	6 26	6 27	6 29	6 30	6 32	6 33	6 35	6 36	6 38	6 40	6 41	6 43	18
19	6 24	6 26	6 27	6 29	6 30	6 32	6 34	6 35	6 37	6 39	6 40	6 42	6 44	6 46	19
20	6 26	6 27	6 29	6 30	6 32	6 34	6 36	6 37	6 39	6 41	6 43	6 45	6 47	6 49	20
21	6 27	6 29	6 30	6 32	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 47	6 49	6 51	21
22	6 28	6 30	6 32	6 34	6 36	6 38	6 39	6 41	6 43	6 45	6 48	6 50	6 52	6 54	22
23	6 30	6 32	6 34	6 36	6 38	6 39	6 42	6 44	6 46	6 48	6 50	6 52	6 54	6 57	23
24	6 31	6 33	6 35	6 37	6 39	6 41	6 44	6 46	6 48	6 50	6 52	6 55	6 57	7 00	24
25	6 33	6 35	6 37	6 39	6 41	6 43	6 46	6 48	6 50	6 53	6 55	6 57	7 00	7 02	25
26	6 34	6 36	6 39	6 41	6 43	6 45	6 48	6 50	6 53	6 55	6 58	7 00	7 03	7 05	26
27	6 36	6 38	6 40	6 43	6 45	6 48	6 50	6 52	6 55	6 58	7 00	7 03	7 06	7 08	27
28	6 37	6 40	6 42	6 45	6 47	6 50	6 52	6 55	6 57	7 00	7 03	7 06	7 09	7 11	28
29	6 39	6 42	6 44	6 47	6 49	6 52	6 54	6 57	7 00	7 03	7 06	7 09	7 12	7 15	29
30	6 41	6 43	6 46	6 49	6 51	6 54	6 57	7 00	7 02	7 05	7 08	7 11	7 15	7 18	30
31	6 42	6 45	6 48	6 51	6 53	6 56	6 59	7 02	7 05	7 08	7 11	7 14	7 18	7 21	31
32	6 44	6 47	6 50	6 53	6 56	6 58	7 01	7 05	7 08	7 11	7 14	7 18	7 21	7 25	32
33	6 46	6 49	6 52	6 55	6 58	7 01	7 04	7 07	7 11	7 14	7 17	7 21	7 24	7 28	33
34	6 48	6 51	6 54	6 57	7 00	7 03	7 07	7 10	7 13	7 17	7 20	7 24	7 28	7 32	34
35	6 49	6 53	6 56	6 59	7 02	7 06	7 09	7 13	7 16	7 20	7 24	7 27	7 31	7 35	35
36	6 51	6 55	6 58	7 01	7 05	7 08	7 12	7 16	7 19	7 23	7 27	7 31	7 35	7 39	36
37	6 53	6 57	7 00	7 04	7 07	7 11	7 15	7 18	7 22	7 26	7 30	7 34	7 39	7 43	37
38	6 55	6 59	7 02	7 06	7 10	7 14	7 17	7 21	7 25	7 30	7 34	7 38	7 43	7 47	38
39	6 57	7 01	7 05	7 09	7 12	7 16	7 20	7 25	7 29	7 33	7 37	7 42	7 47	7 51	39
40	6 59	7 03	7 07	7 11	7 15	7 19	7 23	7 28	7 32	7 37	7 41	7 46	7 51	7 56	40
41	7 02	7 06	7 10	7 14	7 18	7 22	7 27	7 31	7 36	7 40	7 45	7 50	7 55	8 00	41
42	7 04	7 08	7 12	7 17	7 21	7 25	7 30	7 35	7 39	7 44	7 49	7 55	8 00	8 05	42
43	7 06	7 11	7 15	7 19	7 24	7 29	7 33	7 38	7 43	7 48	7 53	7 59	8 04	8 10	43
44	7 09	7 13	7 18	7 22	7 27	7 32	7 37	7 42	7 47	7 52	7 58	8 04	8 09	8 16	44
45	7 11	7 16	7 21	7 25	7 30	7 35	7 40	7 46	7 51	7 57	8 03	8 08	8 15	8 21	45
46	7 14	7 19	7 24	7 29	7 34	7 39	7 44	7 50	7 55	8 01	8 07	8 14	8 20	8 27	46
47	7 17	7 22	7 27	7 32	7 37	7 43	7 48	7 54	8 00	8 06	8 12	8 19	8 26	8 33	47
48	7 19	7 25	7 30	7 35	7 41	7 47	7 53	7 59	8 05	8 11	8 18	8 25	8 32	8 40	48
49	7 22	7 28	7 33	7 39	7 45	7 51	7 57	8 03	8 10	8 17	8 24	8 31	8 38	8 46	49
50	7 25	7 31	7 37	7 43	7 49	7 55	8 02	8 08	8 15	8 22	8 30	8 37	8 45	8 54	50
51	7 29	7 35	7 41	7 47	7 53	8 00	8 06	8 13	8 21	8 28	8 36	8 44	8 53	9 02	51
52	7 32	7 38	7 45	7 51	7 58	8 05	8 12	8 19	8 27	8 35	8 43	8 52	9 01	9 11	52
53	7 36	7 42	7 49	7 56	8 02	8 10	8 17	8 25	8 33	8 41	8 50	9 00	9 09	9 20	53
54	7 40	7 46	7 53	8 00	8 08	8 15	8 23	8 31	8 40	8 49	8 58	9 08	9 19	9 30	54
55	7 44	7 51	7 58	8 05	8 13	8 21	8 29	8 38	8 47	8 57	9 07	9 18	9 29	9 42	55
56	7 48	7 55	8 03	8 11	8 19	8 27	8 36	8 45	8 55	9 05	9 16	9 28	9 41	9 55	56
57	7 52	8 00	8 08	8 16	8 25	8 34	8 43	8 53	9 04	9 15	9 27	9 40	9 54	10 11	57
58	7 57	8 05	8 14	8 22	8 32	8 41	8 51	9 02	9 13	9 25	9 38	9 53	10 10	10 30	58
59	8 02	8 11	8 20	8 29	8 39	8 49	9 00	9 11	9 24	9 37	9 52	10 09	10 29	10 56	59
60	8 08	8 17	8 26	8 36	8 47	8 58	9 09	9 22	9 35	9 51	10 08	10 28	10 55	12 00	60
61	8 14	8 24	8 34	8 44	8 55	9 07	9 20	9 34	9 49	10 07	10 27	10 54	12 00		61
62	8 20	8 31	8 42	8 53	9 05	9 18	9 32	9 47	10 05	10 26	10 54	12 00			62
63	8 27	8 38	8 50	9 02	9 16	9 30	9 46	10 04	10 25	10 53	12 00				63
64	8 35	8 47	9 90	9 13	9 28	9 44	10 02	10 24	10 52	12 00					64
65	8 44	8 57	9 10	9 25	9 42	10 00	10 22	10 51	12 00						65

TABLE XLIV.

For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

	January.						February.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib ...	5 17	4 56	4 34	4 12	3 51	3 30	3 5	2 46	2 26	2 6	1 47	1 28
Schedar ...	5 43	5 21	5 0	4 38	4 17	3 56	3 31	3 11	2 52	2 32	2 13	1 54
Polar Star.	6 10	5 48	5 27	5 5	4 44	4 23	3 58	3 38	3 18	2 59	2 40	2 21
Mirach....	6 13	5 51	5 30	5 8	4 47	4 26	4 1	3 41	3 21	3 2	2 43	2 24
Achernar ..	6 44	6 22	6 1	5 39	5 18	4 57	4 32	4 12	3 52	3 32	3 13	2 55
α ARIETIS ...	7 10	6 48	6 27	6 5	5 44	5 23	4 58	4 38	4 18	3 58	3 39	3 20
Menkar ...	8 6	7 44	7 22	7 1	6 40	6 19	5 54	5 34	5 14	4 54	4 35	4 16
Algol	8 10	7 48	7 26	7 5	6 43	6 22	5 58	5 37	5 17	4 58	4 39	4 20
α Perseus...	8 24	8 3	7 41	7 20	6 58	6 37	6 13	5 52	5 32	5 13	4 54	4 35
ALDEBARAN	9 38	9 16	8 54	8 33	8 12	7 51	7 27	7 6	6 46	6 27	6 8	5 49
Capella....	10 16	9 54	9 32	9 11	8 49	8 29	8 4	7 44	7 24	7 5	6 46	6 27
Rigel	10 18	9 56	9 34	9 13	8 52	8 32	8 7	7 47	7 27	7 7	6 48	6 29
β Taurus....	10 27	10 5	9 44	9 22	9 1	8 40	8 16	7 56	7 36	7 16	6 57	6 38
Bellatrix ..	10 28	10 6	9 44	9 22	9 1	8 40	8 17	7 56	7 36	7 17	6 58	6 39
δ Orion.....	10 35	10 13	9 51	9 30	9 9	8 48	8 24	8 4	7 44	7 24	7 5	6 46
ε Orion	10 40	10 17	9 56	9 34	9 13	8 52	8 28	8 8	7 48	7 28	7 9	6 50
α Columba ..	10 46	10 24	10 2	9 40	9 19	8 58	8 34	8 14	7 54	7 35	7 15	6 56
Betelguese .	10 58	10 36	10 14	9 52	9 31	9 10	8 46	8 26	8 6	7 47	7 28	7 9
Canopus ...	11 32	11 10	10 49	10 27	10 6	9 45	9 20	9 0	8 41	8 21	8 2	7 43
Sirius.....	11 50	11 28	11 6	10 44	10 23	10 2	9 37	9 17	8 58	8 39	8 19	8 0
Castor	12 36	12 14	11 52	11 30	11 9	10 48	10 23	10 3	9 43	9 23	9 5	8 46
Procyon ...	12 42	12 20	11 58	11 37	11 16	10 55	10 30	10 10	9 50	9 30	9 12	8 53
POLLUX ...	12 47	12 25	12 3	11 41	11 20	10 59	10 34	10 14	9 54	9 35	9 16	8 57
ξ Argo Navis	13 10	12 48	12 25	12 4	11 43	11 22	10 57	10 37	10 17	9 58	9 38	9 20
γ Argo Navis	13 16	12 54	12 33	12 11	11 50	11 29	11 4	10 44	10 24	10 4	9 45	9 27
δ Argo Navis	13 52	13 30	13 8	12 47	12 25	12 4	11 40	11 20	11 0	10 40	10 21	10 2
β Argo Navis	14 23	14 1	13 39	13 18	12 57	12 36	12 11	11 51	11 31	11 12	10 52	10 33
Alphard ...	14 30	14 8	13 46	13 26	13 4	12 44	12 19	11 59	11 39	11 19	11 0	10 41
REGULUS ..	15 10	14 48	14 26	14 5	13 45	13 24	12 59	12 39	12 19	11 59	11 40	11 21
β Ursa Major	16 2	15 41	15 18	14 57	14 36	14 16	13 51	13 31	13 11	12 51	12 32	12 13
Dubhe	16 4	15 42	15 20	14 59	14 37	14 17	13 53	13 32	13 12	12 53	12 34	12 15
Deneb.....	16 51	16 29	16 7	15 46	15 25	15 4	14 40	14 20	14 0	13 40	13 21	13 2
γ Ursa Major	16 56	16 34	16 12	15 50	15 29	15 8	14 44	14 24	14 4	13 45	13 25	13 6
α Crux	17 28	17 6	16 44	16 23	16 1	15 40	15 16	14 57	14 37	14 17	13 58	13 39
γ Crux	17 33	17 11	16 49	16 27	16 6	15 45	15 20	15 1	14 41	14 22	14 2	13 43
SPICA.....	18 27	18 5	17 43	17 22	17 1	16 39	16 15	15 55	15 35	15 16	14 57	14 38
Benetnach .	18 52	18 30	18 8	17 46	17 25	17 4	16 39	16 19	15 59	15 40	15 22	15 2
β Centaur ...	19 3	18 41	18 19	17 57	17 36	17 15	16 50	16 30	16 10	15 51	15 32	15 12
α Draco.....	19 11	18 49	18 27	18 6	17 44	17 23	16 59	16 38	16 18	15 59	15 40	15 21
Arcturus ..	19 19	18 56	18 35	18 13	17 52	17 31	17 6	16 46	16 26	16 7	15 48	15 29
Seginus ...	19 35	19 13	18 52	18 31	18 11	17 49	17 24	17 4	16 44	16 24	16 5	15 46
α Centaur...	19 38	19 16	18 56	18 34	18 13	17 52	17 27	17 7	16 47	16 27	16 8	15 49
Zubenesch .	19 51	19 29	19 7	18 47	18 25	18 5	17 40	17 20	17 0	16 40	16 21	16 2
Zubenelg ..	20 18	19 56	19 34	19 13	18 52	18 31	18 6	17 46	17 26	17 7	16 47	16 28
Alphacca ..	20 38	20 15	19 54	19 32	19 12	18 51	18 26	18 6	17 46	17 26	17 7	16 48
α Serpens ...	20 46	20 24	20 2	19 42	19 21	18 59	18 34	18 14	17 54	17 35	17 16	16 57
ANTARES ..	21 29	21 7	20 45	20 23	20 2	19 42	19 17	18 57	18 37	18 18	17 58	17 39
Ras Algethi	22 17	21 55	21 33	21 11	20 50	20 29	20 5	19 45	19 25	19 6	18 41	18 28
Ras Alhague	22 37	22 15	21 53	21 32	21 10	20 49	20 26	20 5	19 46	19 26	19 7	18 48
Rastaban ..	23 3	22 41	22 19	21 57	21 36	21 15	20 50	20 29	20 11	19 52	19 33	19 14
Vega	23 41	23 19	22 57	22 36	22 15	21 54	21 29	21 10	20 50	20 30	20 11	19 52
α AQUILÆ ...	0 56	0 34	0 13	23 47	23 26	23 5	22 40	22 21	22 0	21 41	21 22	21 3
α Pavo	1 26	1 4	0 42	0 10	23 55	23 34	23 9	22 49	22 29	22 10	21 50	21 31
Deneb.....	1 50	1 28	1 6	0 44	0 23	0 2	23 33	23 13	22 54	22 34	22 14	21 55
Alderaimin.	2 29	2 7	1 45	1 23	1 2	0 41	0 16	23 52	23 33	23 13	22 53	22 34
α Aquarius..	3 10	2 48	2 27	2 6	1 44	1 23	0 59	0 38	0 18	23 55	23 36	23 17
α Grux	3 10	2 48	2 27	2 6	1 45	1 24	0 59	0 39	0 19	23 55	23 36	23 17
FOMALHAUT	4 1	3 39	3 17	2 56	2 35	2 14	1 50	1 29	1 10	0 50	0 31	0 12
Scheat . ..	4 8	3 46	3 25	3 3	2 42	2 22	1 57	1 37	1 17	0 57	0 38	0 19
MARCAB..	4 9	3 47	3 25	3 4	2 43	2 23	1 58	1 38	1 18	0 58	0 39	0 20
Alpheratz..	5 13	4 51	4 29	4 7	3 46	3 25	3 0	2 41	2 21	2 1	1 42	1 23

TABLE XLIV.

For finding the APPARENT TIME of the PRINCIPAL STAR's passing the MERIDIAN throughout the YEAR.

	March.						April.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m	h. m.	h. m.	h. m.	h. m.	h. m	h. m.
Algenib ...	1 16	0 57	0 39	0 21	0 2	23 40	23 18	23 1	22 43	22 24	22 6	21 47
Schedar ...	1 42	1 24	1 5	0 47	0 29	0 11	23 45	23 26	23 8	22 50	22 32	22 13
Polar Star.	2 9	1 50	1 32	1 14	0 55	0 37	0 15	23 53	23 35	23 16	22 58	22 39
Mirach....	2 12	1 53	1 34	1 16	0 58	0 40	0 18	23 56	23 37	23 19	23 1	22 42
Achernar ..	2 43	2 24	2 6	1 48	1 29	1 11	0 49	0 31	0 13	23 50	23 32	23 13
α ARIETIS ...	3 9	2 50	2 32	2 14	1 55	1 37	1 15	0 57	0 39	0 20	23 58	23 39
Menkar ...	4 4	3 45	3 27	3 9	2 51	2 33	2 11	1 53	1 35	1 16	0 58	0 39
Algol	4 7	3 49	3 30	3 13	2 55	2 37	2 15	1 57	1 38	1 20	1 1	0 43
α Perseus...	4 22	4 4	3 45	3 28	3 10	2 52	2 30	2 12	1 53	1 35	1 16	0 58
ALDEBARAN	5 37	5 18	4 59	4 41	4 23	4 5	3 43	3 25	3 7	2 49	2 30	2 12
Capella....	6 14	5 56	5 37	5 19	5 1	4 43	4 21	4 3	3 44	3 26	3 8	2 50
Rigel	6 17	5 58	5 40	5 21	5 3	4 45	4 23	4 5	3 47	3 28	3 11	2 52
β Taurus....	6 26	6 7	5 49	5 30	5 12	4 54	4 32	4 14	3 56	3 37	3 19	3 1
Bellatrix ..	6 26	6 8	5 49	5 31	5 13	4 55	4 33	4 16	3 56	3 38	3 19	3 2
δ Orion.....	6 34	6 15	5 57	5 38	5 20	5 2	4 40	4 22	4 4	3 45	3 27	3 9
ε Orion	6 38	6 19	6 1	5 43	5 24	5 6	4 44	4 26	4 8	3 49	3 31	3 12
α Columba ..	6 44	6 25	6 7	5 49	5 30	5 12	4 51	4 32	4 14	3 56	3 37	3 18
Betelguese .	6 56	6 38	6 19	6 1	5 43	5 25	5 3	5 45	4 26	4 8	3 49	3 31
Canopus ...	7 31	7 12	6 54	6 35	6 17	5 59	5 37	5 19	5 1	4 42	4 24	4 5
Sirius.....	7 48	7 29	7 11	6 53	6 35	6 16	5 55	5 36	5 18	5 0	4 41	4 22
Castor	8 34	8 15	7 57	7 39	7 20	7 2	6 40	6 22	6 4	5 46	5 27	5 8
Procyon ...	8 41	8 22	8 4	7 45	7 27	7 9	6 47	6 29	6 11	5 52	5 34	5 15
POLLUX ...	8 45	8 27	8 8	7 50	7 32	7 13	6 52	6 33	6 15	5 57	5 38	5 19
ξ Argo Navis	9 8	8 50	8 31	8 13	7 55	7 36	7 15	6 56	6 38	6 20	6 1	5 42
γ Argo Navis	9 15	8 56	8 38	8 20	8 1	7 43	7 21	7 3	6 45	6 26	6 8	5 49
δ Argo Navis	9 50	9 32	9 14	8 55	8 37	8 19	7 57	7 39	7 21	7 2	6 44	6 25
β Argo Navis	10 21	10 3	9 44	9 27	9 9	8 50	8 29	8 10	7 52	7 34	7 15	6 56
Alphard ...	10 29	10 10	9 52	9 34	9 16	8 58	8 36	8 18	8 0	7 41	7 23	7 4
REGULUS ..	11 9	10 50	10 32	10 13	9 56	9 38	9 16	8 58	8 40	8 21	8 3	7 44
β Ursa Major	12 1	11 42	11 24	11 5	10 47	10 29	10 7	9 50	9 32	9 13	8 55	8 36
Dubhe	12 2	11 44	11 25	11 7	10 49	10 31	10 9	9 52	9 33	9 15	8 56	8 38
Deneb.....	12 50	12 31	12 13	11 54	11 36	11 18	10 56	10 38	10 20	10 1	9 43	9 25
γ Ursa Major	12 54	12 36	12 17	11 59	11 41	11 22	11 1	10 42	10 24	10 8	9 47	9 29
α Crux	13 27	13 8	12 50	12 31	12 13	11 55	11 33	11 15	10 57	10 38	10 20	10 1
γ Crux	13 31	13 13	12 54	12 36	12 18	11 59	11 38	11 19	11 1	10 44	10 24	10 5
SPICA.....	14 26	14 7	13 49	13 30	13 12	12 54	12 32	12 14	11 56	11 38	11 19	11 0
Benetnach .	14 50	14 32	14 13	13 55	13 37	13 19	12 57	12 39	12 20	12 3	11 43	11 25
β Centaur ...	15 1	14 42	14 24	14 6	13 48	13 29	13 8	12 49	12 31	12 13	11 54	11 35
α Draco.....	15 9	14 51	14 32	14 14	13 56	13 38	13 16	12 58	12 39	12 21	12 2	11 44
Arcturus ..	15 17	14 59	14 40	14 22	14 4	13 46	13 24	13 6	12 47	12 29	12 10	11 52
Seginus ...	15 35	15 16	14 57	14 39	14 21	14 3	13 41	13 23	13 5	12 46	12 28	12 9
α Centaur...	15 38	15 19	15 0	14 43	14 24	14 6	13 44	13 26	13 8	12 49	12 31	12 12
Zubenesch .	15 51	15 32	15 13	14 55	14 37	14 19	13 57	13 39	13 21	13 2	12 44	12 25
Zubenelg ..	16 16	15 59	15 39	15 22	15 4	14 45	14 24	14 5	13 47	13 29	13 10	12 51
Alphacca ..	16 36	16 17	15 59	15 42	15 23	15 5	14 44	14 25	14 7	13 48	13 30	13 11
α Serpens ...	16 44	16 26	16 7	15 50	15 32	15 14	14 52	14 34	14 15	13 57	13 38	13 20
ANTARES ..	17 27	17 9	16 50	16 32	16 15	15 57	15 35	15 17	14 58	14 40	14 21	14 2
Ras Algethi	18 15	17 57	17 38	17 20	17 2	16 44	16 23	16 5	15 46	15 28	15 9	14 51
Ras Alhague	18 35	18 17	17 58	17 40	17 22	17 4	16 41	16 25	16 6	15 48	15 29	15 11
Rastaban ..	19 1	18 43	18 24	18 6	17 48	17 30	17 8	16 50	16 31	16 13	15 55	15 37
Vega	19 48	19 21	19 3	18 44	18 26	18 8	17 46	17 28	17 10	16 51	16 33	16 14
α AQUILÆ ...	20 51	20 32	20 14	19 56	19 37	19 19	18 57	18 39	18 21	18 2	17 44	17 25
α Pavo	21 20	21 2	20 43	20 25	20 7	19 48	19 27	19 8	18 50	18 32	18 13	17 54
Deneb.....	21 44	21 26	21 7	20 49	20 31	20 12	19 51	19 32	19 14	18 56	18 37	18 18
Alderaimin.	22 23	22 5	21 45	21 28	21 10	20 51	20 30	20 11	19 53	19 35	19 16	18 57
α Aquarius..	23 4	22 46	22 27	22 10	21 52	21 34	21 12	20 54	20 35	20 17	19 58	19 40
α Grux	23 5	22 46	22 28	22 10	21 52	21 34	21 12	20 54	20 36	20 17	19 59	19 40
FOMALHAUT	23 56	23 37	23 19	23 1	22 43	22 25	22 3	21 45	21 27	21 8	20 50	20 31
Scheat	0 7	23 44	23 26	23 8	22 50	22 32	22 10	21 52	21 34	21 15	20 57	20 38
MARCAB...	0 8	23 45	23 27	23 8	22 51	22 33	22 10	21 53	21 35	21 16	20 58	20 39
Alpheratz..	1 11	0 52	0 34	0 16	23 53	23 35	23 13	22 56	22 38	22 20	22 1	21 42

TABLE XLIV.

For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

	May.						June.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib ...	21 28	21 9	20 50	20 30	20 10	19 50	19 26	19 5	18 44	18 24	18 3	17 42
Schedar ...	21 54	21 34	21 16	20 56	20 36	20 16	19 52	19 31	19 11	18 50	18 29	18 8
Polar Star .	22 20	22 1	21 42	21 22	21 2	20 43	20 19	19 58	19 37	19 17	18 56	18 35
Mirach	22 23	22 4	21 44	21 25	21 5	20 46	20 20	20 1	19 40	19 19	18 58	18 38
Achernar ..	22 51	22 35	22 16	21 56	21 36	21 16	20 52	20 31	20 11	19 51	19 30	19 9
α Arietis ...	23 20	23 1	22 42	22 22	22 2	21 42	21 18	20 57	20 36	20 17	19 56	19 35
Menkar ...	0 20	0 1	23 37	23 18	22 58	22 38	22 13	21 53	21 32	21 11	20 51	20 30
Algol	0 24	0 4	23 41	23 21	23 2	22 41	22 17	21 56	21 36	21 15	20 54	20 33
α Perseus...	0 39	0 20	23 56	23 36	23 17	22 56	22 32	22 12	21 51	21 30	21 9	20 49
Aldebaran	1 53	1 34	1 14	0 55	0 35	0 15	23 46	23 26	23 5	22 44	22 23	22 3
Capella....	2 31	2 11	1 52	1 32	1 12	0 52	0 28	0 7	23 43	23 22	23 1	22 40
Rigel	2 33	2 14	1 54	1 35	1 15	0 55	0 30	0 10	23 45	23 24	23 4	22 43
β Taurus....	2 42	2 23	2 4	1 44	1 24	1 4	0 39	0 19	23 54	23 33	23 13	22 52
Bellatrix ..	2 43	2 23	2 4	1 44	1 25	1 4	0 40	0 19	23 55	23 34	23 13	22 52
δ Orion.....	2 50	2 31	2 11	1 52	1 32	1 12	0 47	0 27	0 6	23 41	23 21	23 0
ε Orion	2 54	2 35	2 16	1 56	1 36	1 16	0 52	0 31	0 10	23 46	23 25	23 4
α Columba ..	3 0	2 41	2 22	2 2	1 42	1 22	0 58	0 37	0 16	23 52	23 31	23 10
Betelguese .	3 11	2 53	2 34	2 14	1 54	1 34	1 10	0 49	0 29	0 8	23 43	23 22
Canopus ...	3 46	3 27	3 9	2 49	2 29	2 9	1 44	1 24	1 3	0 43	0 22	0 1
Sirius.....	4 3	3 44	3 25	3 6	2 46	2 26	2 2	1 41	1 21	1 0	0 39	0 18
Castor	4 49	4 30	4 11	3 51	3 31	3 11	2 48	2 27	2 6	1 46	1 25	1 4
Procyon ...	4 56	4 37	4 17	3 58	3 38	3 18	2 54	2 34	2 13	1 52	1 32	1 11
Pollux ...	5 0	4 41	4 22	4 2	3 42	3 22	2 59	2 38	2 18	1 57	1 36	1 15
ξ Argo Navis	5 23	5 4	4 45	4 25	4 5	3 45	3 21	3 0	2 41	2 20	1 59	1 38
γ Argo Navis	5 30	5 11	4 52	4 32	4 12	3 52	3 28	3 7	2 47	2 27	2 6	1 45
δ Argo Navis	6 6	5 47	5 27	5 8	4 48	4 28	4 3	3 43	3 22	3 1	2 42	2 21
β Argo Navis	6 37	6 18	5 59	5 39	5 19	4 59	4 35	4 14	3 54	3 33	3 12	2 51
Alphard ...	6 45	6 26	6 6	5 47	5 27	5 7	4 42	4 22	4 1	3 40	3 20	2 59
Regulus ..	7 25	7 6	6 46	6 27	6 7	5 47	5 22	5 2	4 41	4 20	4 0	3 39
β Ursa Major	8 17	7 58	7 38	7 19	6 59	6 39	6 14	5 54	5 33	5 12	4 52	4 31
Dubhe	8 19	8 0	7 40	7 20	7 1	6 40	6 16	5 56	5 35	5 14	4 53	4 33
Deneb.....	9 6	8 47	8 27	8 8	7 48	7 28	7 3	6 43	6 22	6 1	5 41	5 20
γ Ursa Major	9 10	8 51	8 32	8 12	7 52	7 32	7 8	6 47	6 27	6 6	5 45	5 24
α Crux	9 42	9 23	9 4	8 45	8 25	8 5	7 40	7 20	6 59	6 38	6 17	5 57
γ Crux	9 46	9 27	9 9	8 49	8 29	8 9	7 45	7 24	7 4	6 43	6 22	6 1
Spica.....	10 41	10 22	10 2	9 43	9 23	9 3	8 39	8 18	7 58	7 37	7 17	6 56
Benetnach .	11 6	10 46	10 27	10 8	9 47	9 27	9 3	8 43	8 23	8 2	7 41	7 20
β Centaur ...	11 16	10 57	10 38	10 18	9 58	9 38	9 14	8 55	8 34	8 13	7 52	7 31
α Draco.....	11 25	11 6	10 46	10 26	10 7	9 46	9 22	9 2	8 41	8 21	8 0	7 40
Arcturus ..	11 33	11 13	10 54	10 34	10 14	9 54	9 30	9 10	8 49	8 29	8 8	7 47
Seginus ...	11 50	11 31	11 11	10 52	10 32	10 12	9 47	9 27	9 6	8 46	8 26	8 5
α Centaur...	11 53	11 34	11 15	10 55	10 35	10 15	9 51	9 30	9 9	8 49	8 29	8 8
Zubenesch .	12 6	11 47	11 27	11 3	10 48	10 28	10 3	9 43	9 22	9 1	8 42	8 21
Zubenelg ..	12 33	12 13	11 54	11 34	11 14	10 54	10 30	10 9	9 49	9 28	9 7	8 46
Alphacca ..	12 52	12 33	12 14	11 54	11 34	11 14	10 50	10 29	10 8	9 48	9 27	9 6
α Serpens ...	13 1	12 41	12 22	12 2	11 42	11 22	10 58	10 37	10 17	9 56	9 35	9 14
Antares ..	13 44	13 24	13 5	12 45	12 25	12 5	11 41	11 20	11 0	10 39	10 18	9 57
Ras Algethi	14 32	14 12	13 53	13 33	13 13	12 53	12 29	12 8	11 48	11 27	11 6	10 45
Ras Alhague	14 52	14 33	14 13	13 54	13 34	13 14	12 49	12 29	12 8	11 47	11 26	11 6
Rastaban ..	15 18	14 58	14 39	14 19	13 59	13 39	13 15	12 54	12 34	12 13	11 52	11 31
Vega	15 55	15 36	15 17	14 58	14 38	14 18	13 53	13 33	13 12	12 51	12 31	12 10
α Aquilæ ...	17 6	16 47	16 28	16 8	15 48	15 28	15 4	14 43	14 23	14 3	13 42	13 21
α Pavo	17 36	17 16	16 57	16 37	16 17	15 57	15 33	15 12	14 52	14 31	14 11	13 50
Deneb.....	17 59	17 40	17 21	17 1	16 41	16 21	15 57	15 36	15 16	14 55	14 34	14 14
Alderaimin.	18 38	18 19	18 0	17 40	17 20	17 0	16 36	16 15	15 55	15 34	15 13	14 52
α Aquarius..	19 21	19 2	18 42	18 22	18 3	17 42	17 18	16 58	16 37	16 16	15 55	15 35
α Grux	19 21	19 2	18 42	18 23	18 3	17 43	17 18	16 58	16 37	16 16	15 56	15 35
Fomalhaut	20 12	19 53	19 33	19 14	18 54	18 34	18 9	17 49	17 28	17 7	16 46	16 26
Scheat	20 19	20 0	19 41	19 21	19 1	18 41	18 17	17 56	17 35	17 15	16 54	16 33
Marcab...	20 20	20 1	19 41	19 22	19 2	18 42	18 17	17 57	17 36	17 15	16 55	16 34
Alpheratz..	21 23	21 4	20 45	20 25	20 5	19 45	19 21	19 0	18 39	18 19	17 58	17 37

TABLE XLIV.

For finding the APPARENT TIME of the PRINCIPAL STAR's passing the MERIDIAN throughout the YEAR.

	July.						August.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m	h. m.
Algenib ...	17 21	17 1	16 40	16 20	16 0	15 40	15 17	14 58	14 39	14 20	14 2	13 43
Schedar ...	17 48	17 27	17 6	16 46	16 26	16 6	15 43	15 24	15 5	14 47	14 28	14 9
Polar Star.	18 14	17 54	17 33	17 13	16 53	16 33	16 9	15 50	15 32	15 13	14 55	14 36
Mirach....	18 17	17 56	17 36	17 15	16 55	16 36	16 12	15 53	15 35	15 16	14 57	14 39
Achernar ..	18 48	18 28	18 7	17 47	17 27	17 7	16 43	16 24	16 6	15 47	15 29	15 10
α Arietis...	19 14	18 54	18 33	18 13	17 53	17 33	17 9	16 50	16 31	16 12	15 55	15 36
Menkar ...	20 10	19 50	19 29	19 9	18 49	18 29	18 5	17 46	17 27	17 8	16 49	16 31
Algol	20 14	19 53	19 33	19 12	18 52	18 33	18 9	17 50	17 30	17 12	16 53	16 35
α Perseus...	20 29	20 8	19 48	19 27	19 7	18 47	18 24	18 5	17 46	17 27	17 8	16 50
Aldebaran	21 42	21 21	21 1	20 41	20 21	20 1	19 38	19 19	19 0	18 41	18 22	18 4
Capella....	22 20	21 59	21 39	21 18	20 59	20 39	20 16	19 56	19 37	19 19	19 0	18 42
Rigel	22 22	22 2	21 41	21 21	21 2	20 42	20 18	19 59	19 40	19 21	19 2	18 44
β Taurus....	22 31	22 11	21 50	21 30	21 10	20 51	20 27	20 8	19 49	19 30	19 11	18 53
Bellatrix ..	22 32	22 11	21 51	21 30	21 10	20 51	20 28	20 9	19 49	19 31	19 12	18 54
δ Orion.....	22 39	22 18	21 58	21 38	21 18	20 58	20 35	20 16	19 57	19 38	19 19	19 1
ε Orion	22 43	22 23	22 2	21 42	21 22	21 2	20 39	20 20	20 1	19 42	19 24	19 5
α Columba ..	22 49	22 29	22 8	21 48	21 28	21 8	20 46	20 26	20 7	19 48	19 30	19 11
Betelguese .	23 2	22 41	22 21	22 0	21 40	21 20	20 58	20 39	20 19	20 1	19 42	19 21
Canopus ...	23 36	23 16	22 55	22 35	22 15	21 55	21 32	21 13	20 54	20 35	20 17	19 58
Sirius.....	23 53	23 33	23 12	22 52	22 32	22 12	21 50	21 30	21 11	20 52	20 31	20 15
Castor	0 43	0 23	0 2	23 38	23 18	22 58	22 34	22 15	21 56	21 38	21 20	21 1
Procyon ...	0 50	0 30	0 9	23 45	23 25	23 5	22 41	22 22	22 3	21 45	21 26	21 8
Pollux ...	0 55	0 34	0 13	23 49	23 29	23 9	22 46	22 26	22 7	21 50	21 31	21 12
ξ Argo Navis	1 18	0 57	0 36	0 16	23 52	23 32	23 9	22 49	22 30	22 12	21 54	21 35
γ Argo Navis	1 24	1 4	0 43	0 23	0 3	23 39	23 15	22 56	22 37	22 19	22 1	21 42
δ Argo Navis	2 0	1 39	1 19	0 59	0 38	0 19	23 51	23 32	23 13	22 54	22 36	22 18
β Argo Navis	2 31	2 11	1 50	1 30	1 10	0 50	0 27	0 7	23 44	23 25	23 7	22 49
Alphard ...	2 39	2 18	1 58	1 38	1 18	0 58	0 34	0 15	23 52	23 33	23 14	22 56
Regulus ..	3 18	2 58	2 38	2 18	1 58	1 38	1 14	0 55	0 36	0 17	23 54	23 36
β Ursa Major	4 10	3 50	3 29	3 10	2 50	2 30	2 6	1 47	1 28	1 9	0 51	0 32
Dubhe	4 12	3 51	3 31	3 11	2 51	2 31	2 8	1 49	1 30	1 11	0 52	0 34
Deneb.....	4 59	4 39	4 18	3 58	3 38	3 18	2 55	2 36	2 17	1 58	1 39	1 21
γ Ursa Major	5 4	4 43	4 22	4 2	3 42	3 22	3 0	2 40	2 21	2 3	1 44	1 26
α Crux	5 36	5 15	4 55	4 35	4 14	3 55	3 31	3 12	2 54	2 35	2 17	1 58
γ Crux	5 40	5 20	4 59	4 39	4 19	3 59	3 36	3 16	2 58	2 39	2 21	2 2
Spica.....	6 35	6 14	5 54	5 34	5 13	4 54	4 30	4 11	3 52	3 33	3 15	2 57
Benetnach .	7 0	6 39	6 19	5 58	5 38	5 18	4 55	4 36	4 16	3 58	3 39	3 22
β Centaur ...	7 10	6 50	6 29	6 9	5 49	5 29	5 6	4 46	4 27	4 8	3 50	3 31
α Draco.....	7 19	6 58	6 38	6 17	5 57	5 37	5 14	4 55	4 36	4 17	3 58	3 40
Arcturus ..	7 27	7 6	6 46	6 25	6 5	5 45	5 22	5 3	4 43	4 25	4 6	3 48
Seginus ...	7 44	7 23	7 3	6 43	6 23	6 3	5 39	5 20	5 1	4 42	4 23	4 5
α Centaur...	7 47	7 27	7 6	6 46	6 26	6 6	5 42	5 23	5 4	4 45	4 27	4 8
Zubenesch .	8 0	7 39	7 19	6 59	6 39	6 19	5 55	5 36	5 17	4 58	4 39	4 21
Zubenelg ..	8 27	8 6	7 45	7 25	7 5	6 45	6 22	6 2	5 43	5 25	5 6	4 47
Alphacca ..	8 46	8 26	8 5	7 45	7 25	7 5	6 41	6 22	6 3	5 44	5 26	5 7
α Serpens ...	8 55	8 34	8 14	7 53	7 33	7 13	6 50	6 30	6 11	5 53	5 34	5 16
Antares ..	9 37	9 16	8 57	8 36	8 16	7 56	7 33	7 13	6 54	6 36	6 17	5 59
Ras Algethi	10 25	10 5	9 44	9 23	9 4	8 44	8 21	8 2	7 42	7 24	7 5	6 47
Ras Alhague	10 45	10 24	10 4	9 43	9 23	9 3	8 41	8 22	8 3	7 44	7 25	7 7
Rastaban ..	11 11	10 50	10 30	10 9	9 49	9 29	9 7	8 48	8 28	8 10	7 51	7 33
Vega	11 49	11 28	11 8	10 48	10 28	10 8	9 44	9 26	9 7	8 48	8 29	8 11
α Aquilæ ...	13 0	12 40	12 19	11 59	11 39	11 19	10 55	10 36	10 17	9 59	9 41	9 22
α Pavo	13 30	13 9	12 48	12 28	12 8	11 48	11 25	11 5	10 46	10 28	10 9	9 51
Deneb.....	13 54	13 33	13 12	12 52	12 32	12 12	11 49	11 29	11 10	10 51	10 33	10 14
Alderaimin.	14 33	14 12	13 51	13 31	13 11	12 51	12 28	12 8	11 49	11 30	11 12	10 53
α Aquarius..	15 14	14 53	14 34	14 13	13 53	13 33	13 10	12 51	12 32	12 13	11 54	11 36
α Grux	15 14	14 53	14 34	14 14	13 54	13 34	13 10	12 51	12 32	12 13	11 54	11 36
Fomalhaut	16 5	15 44	15 24	15 5	14 44	14 25	14 1	13 42	13 23	13 4	12 45	12 27
Scheat	16 12	15 52	15 31	15 11	14 52	14 32	14 8	13 49	13 30	13 11	12 53	12 34
Marcab...	16 13	15 52	15 32	15 12	14 53	14 33	14 9	13 50	13 31	13 12	12 53	12 35
Alpheratz..	17 16	16 56	16 35	16 15	15 55	15 35	15 12	14 53	14 34	14 15	13 57	13 38

TABLE XLIV.

For finding the APPARENT TIME of the PRINCIPAL STAR'S passing the MERIDIAN throughout the YEAR.

	September.						October.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib ...	13 21	13 3	12 45	12 27	12 9	11 51	11 33	11 15	10 57	10 38	10 19	10 0
Schedar ...	13 48	13 30	13 10	12 54	12 36	12 18	12 0	11 41	11 23	11 4	10 46	10 27
Polar Star.	14 14	13 56	13 37	13 20	13 2	12 44	12 26	12 8	11 50	11 31	11 12	10 53
Mirach....	14 17	14 6	13 40	13 23	13 5	12 47	12 29	12 11	11 52	11 34	11 15	10 56
Achernar ..	14 48	14 30	14 12	13 54	13 36	13 18	13 0	12 42	12 24	12 5	11 46	11 27
α ARIETIS...	15 14	14 56	14 38	14 20	14 2	13 44	13 26	13 8	12 50	12 31	12 12	11 53
Menkar ...	16 10	15 52	15 34	15 16	14 58	14 40	14 22	14 4	13 46	13 27	13 8	12 49
Algol	16 14	15 56	15 38	15 20	15 2	14 44	14 26	14 7	13 49	13 31	13 12	12 53
α Perseus...	16 29	16 11	15 53	15 35	15 17	14 59	14 41	14 23	14 4	13 46	13 27	13 8
ALDEBARAN	17 42	17 24	17 6	16 49	16 31	16 13	15 55	15 37	15 18	15 0	14 41	14 22
Capella....	18 20	18 2	17 44	17 26	17 9	16 50	16 33	16 14	15 56	15 38	15 19	15 0
Rigel	18 22	18 4	17 46	17 28	17 10	16 52	16 35	16 17	16 0	15 40	15 21	15 2
β Taurus....	18 31	18 13	17 55	17 37	17 19	17 1	16 44	16 26	16 8	15 49	15 30	15 11
Bellatrix ..	18 32	18 14	17 56	17 38	17 20	17 2	16 45	16 26	16 8	15 50	15 31	15 12
δ Orion.....	18 39	18 21	18 3	17 45	17 27	17 9	16 51	16 34	16 15	15 57	15 38	15 19
ε Orion.....	18 43	18 25	18 7	17 49	17 31	17 13	16 55	16 37	16 20	16 1	15 42	15 23
α Columba ..	18 49	18 31	18 13	17 55	17 37	17 19	17 1	16 43	16 26	16 7	15 48	15 29
Betelguese .	19 2	18 44	18 26	18 8	17 50	17 32	17 14	16 55	16 37	16 20	16 0	15 42
Canopus ...	19 36	19 18	19 0	18 42	18 24	18 6	17 48	17 30	17 12	16 53	16 34	16 15
Sirius.....	19 53	19 35	19 17	18 59	18 41	18 23	18 5	17 47	17 29	17 10	16 52	16 32
Castor	20 39	20 21	20 3	19 45	19 27	19 9	18 51	18 33	18 15	17 57	17 37	17 18
Procyon ...	20 46	20 28	20 10	19 52	19 34	19 16	18 58	18 40	18 22	18 4	17 44	17 25
POLLUX ...	20 51	20 32	20 14	19 56	19 39	19 21	19 2	18 44	18 27	18 7	17 49	17 30
ξ Argo Navis	21 14	20 55	20 37	20 19	20 1	19 44	19 25	19 7	18 49	18 30	18 12	17 53
γ Argo Navis	21 20	21 2	20 44	20 26	20 8	19 50	19 32	19 14	18 56	18 37	18 18	18 0
δ Argo Navis	21 56	21 38	21 20	21 2	20 44	20 26	20 8	19 50	19 31	19 13	18 54	18 35
β Argo Navis	22 26	22 9	21 51	21 33	21 15	20 57	20 39	20 21	20 3	19 44	19 26	19 6
Alphard ...	22 34	22 17	22 0	21 41	21 23	21 5	20 47	20 29	20 10	19 52	19 33	19 14
REGULUS ..	23 14	22 57	22 39	22 21	22 3	21 45	21 27	21 9	20 50	20 32	20 13	19 54
β Ursa Major	0 10	23 48	23 30	23 12	22 55	22 37	22 19	22 1	21 43	21 24	21 5	20 46
Dubhe	0 12	23 50	23 32	23 14	22 57	22 39	22 21	22 3	21 44	21 26	21 7	20 48
Deneb.....	0 59	0 41	0 23	0 5	23 43	23 25	23 8	22 50	22 32	22 13	21 54	21 35
γ Ursa Major	1 4	0 45	0 27	0 10	23 48	23 30	23 12	22 54	22 36	22 17	22 0	21 40
α Crux	1 36	1 18	1 0	0 42	0 24	0 6	23 44	23 26	23 8	22 50	22 31	22 12
γ Crux	1 40	1 22	1 4	0 46	0 28	0 10	23 48	23 30	23 12	22 54	22 36	22 16
SPICA.....	2 35	2 17	1 59	1 41	1 23	1 5	0 47	0 29	0 10	23 48	23 30	23 10
Benetnach .	3 0	2 42	2 24	2 6	1 48	1 30	1 12	0 53	0 35	0 17	23 54	23 35
β Centaur...	3 10	2 52	2 34	2 16	1 58	1 40	1 22	1 4	0 46	0 27	0 9	23 45
α Draco.....	3 19	3 1	2 43	2 25	2 7	1 49	1 31	1 13	0 54	0 36	0 17	23 54
Arcturus ..	3 26	3 9	2 51	2 33	2 15	1 57	1 39	1 20	1 2	0 44	0 25	0 6
Seginus ...	3 43	3 26	3 8	2 50	2 32	2 14	1 56	1 38	1 19	1 1	0 42	0 23
α Centaur...	3 46	3 29	3 11	2 53	2 35	2 17	1 59	1 41	1 23	1 4	0 45	0 26
Zubenesch .	3 59	3 41	3 24	3 6	2 48	2 30	2 12	1 54	1 35	1 17	0 58	0 39
Zubenelg ..	4 26	4 7	3 49	3 32	3 15	2 57	2 39	2 20	2 2	1 43	1 25	1 6
Alphacca ..	4 45	4 27	4 9	3 51	3 34	3 16	2 58	2 40	2 22	2 3	1 44	1 25
α Serpens...	4 54	4 36	4 18	4 0	3 42	3 24	3 7	2 48	2 30	2 12	1 53	1 34
ANTARES ..	5 37	5 19	5 1	4 43	4 25	4 7	3 49	3 30	3 13	2 54	2 36	2 17
Ras Algethi	6 25	6 7	5 49	5 31	5 13	4 55	4 37	4 18	4 0	3 42	3 23	3 5
Ras Alhague	6 45	6 27	6 9	5 51	5 33	5 15	4 57	4 39	4 20	4 2	3 43	3 24
Rastaban ..	7 11	6 53	6 35	6 17	5 59	5 41	5 23	5 4	4 46	4 27	4 9	3 50
Vega	7 49	7 31	7 13	6 55	6 37	6 19	6 1	5 43	5 25	5 6	4 47	4 28
α AQUILÆ ...	9 0	8 42	8 24	8 6	7 48	7 30	7 12	6 54	6 36	6 17	5 58	5 39
α Pavo	9 30	9 11	8 53	8 36	8 18	8 0	7 42	7 23	7 5	6 46	6 28	6 9
Deneb.....	9 54	9 35	9 17	8 59	8 42	8 24	8 5	7 47	7 29	7 10	6 52	6 33
Alderaimin.	10 32	10 13	9 56	9 38	9 21	9 3	8 44	8 26	8 8	7 49	7 31	7 12
α Aquarius..	11 14	10 56	10 38	10 20	10 3	9 45	9 27	9 9	8 50	8 32	8 13	7 54
α Grux	11 14	10 56	10 38	10 20	10 3	9 45	9 27	9 9	8 50	8 32	8 13	7 51
FOMALHAUT	12 5	11 47	11 29	11 11	10 53	10 35	10 17	10 0	9 41	9 23	9 4	8 45
Scheat	12 12	11 54	11 36	11 18	11 0	10 42	10 24	10 6	9 50	9 30	9 11	8 52
MARCAB...	12 13	11 55	11 37	11 19	11 1	10 43	10 25	10 7	9 50	9 31	9 12	8 53
Alpheratz..	13 16	12 58	12 40	12 22	12 4	11 46	11 28	11 10	10 52	10 33	10 14	9 55

TABLE XLIV.

For finding the APPARENT TIME of the PRINCIPAL STAR's passing the MERIDIAN throughout the YEAR.

	November.						December.					
	1	6	11	16	21	26	1	6	11	16	21	26
	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
Algenib ...	9 37	9 17	8 57	8 38	8 17	7 56	7 34	7 12	6 50	6 28	6 6	5 44
Schedar ...	10 3	9 41	9 23	9 3	8 42	8 22	8 1	7 39	7 17	6 55	6 33	6 10
Polar Star.	10 30	10 10	9 50	9 30	9 9	8 48	8 27	8 5	7 44	7 21	6 59	6 37
Mirach....	10 33	10 13	9 53	9 32	9 11	8 50	8 30	8 8	7 46	7 24	7 2	6 40
Achernar ..	11 4	10 44	10 24	10 4	9 43	9 22	9 0	8 38	8 18	7 55	7 33	7 11
α ARIETIS ...	11 30	11 10	10 50	10 30	10 9	9 48	9 26	9 5	8 43	8 20	7 59	7 37
Menkar ...	12 26	12 6	11 46	11 26	11 5	10 44	10 22	10 0	9 38	9 16	8 54	8 32
Algol	12 29	12 10	11 50	11 29	11 8	10 47	10 26	10 4	9 42	9 20	8 58	8 35
α Perseus...	12 44	12 25	12 5	11 44	11 23	11 2	10 41	10 19	9 57	9 35	9 13	8 51
ALDEBARAN	14 0	13 39	13 19	12 58	12 37	12 16	11 55	11 33	11 11	10 49	10 27	10 5
Capella....	14 36	14 17	13 57	13 36	13 15	12 54	12 33	12 11	11 49	11 27	11 5	10 42
Rigel	14 39	14 19	13 59	13 39	13 18	12 57	12 35	12 13	11 51	11 29	11 7	10 45
β Taurus....	14 48	14 28	14 8	13 48	13 27	13 6	12 44	12 22	12 0	11 38	11 16	10 54
Bellatrix ..	14 48	14 29	14 9	13 48	13 27	13 6	12 45	12 23	12 1	11 39	11 17	10 54
δ Orion.....	14 56	14 36	14 16	13 55	13 35	13 13	12 52	12 30	12 8	11 46	11 24	11 2
ε Orion	15 0	14 40	14 20	14 0	13 39	13 18	12 56	12 35	12 13	11 50	11 28	11 6
α Columba ..	15 6	14 46	14 26	14 6	13 45	13 24	13 2	12 41	12 19	11 57	11 34	11 12
Betelguese .	15 18	14 58	14 39	14 18	13 57	13 36	13 15	12 53	12 31	12 9	11 47	11 24
Canopus ...	15 52	15 33	15 12	14 53	14 31	14 11	13 49	13 27	13 4	12 44	12 21	11 59
Sirius.....	16 9	15 49	15 29	15 9	14 48	14 27	14 6	13 45	13 22	13 1	12 38	12 16
Castor	16 55	16 35	16 15	15 55	15 34	15 13	14 51	14 30	14 8	13 46	13 24	13 2
Procyon ...	17 2	16 42	16 22	16 2	15 41	15 20	14 58	14 36	14 14	13 52	13 30	13 9
POLLUX ...	17 6	16 46	16 26	16 6	15 45	15 24	15 2	14 41	14 19	13 57	13 31	13 13
ξ Argo Navis	17 29	17 9	16 49	16 29	16 8	15 47	15 25	15 4	14 42	14 20	13 57	13 35
γ Argo Navis	17 36	17 16	16 56	16 37	16 15	15 54	15 32	15 10	14 49	14 26	14 4	13 42
δ Argo Navis	18 12	17 52	17 32	17 11	16 51	16 29	16 8	15 46	15 24	15 2	14 40	14 18
β Argo Navis	18 43	18 23	18 3	17 43	17 22	17 1	16 39	16 18	15 56	15 34	15 11	14 49
Alphard ...	18 51	18 31	18 11	17 50	17 30	17 8	16 47	16 25	16 3	15 41	15 19	14 57
REGULUS ..	19 31	19 11	18 51	18 30	18 10	17 48	17 27	17 5	16 43	16 21	15 59	15 37
β Ursa Major	20 23	20 3	19 43	19 23	19 2	18 41	18 19	17 57	17 35	17 13	16 51	16 29
Dubhe	20 24	20 5	19 45	19 24	19 3	18 42	18 21	17 59	17 37	17 15	16 53	16 31
Deneb.....	21 12	20 52	20 32	20 11	19 51	19 30	19 8	18 46	18 24	18 2	17 40	17 18
γ Ursa Major	21 16	20 56	20 36	20 16	19 55	19 34	19 13	18 51	18 29	18 7	17 45	17 22
α Crux	21 49	21 28	21 8	20 48	20 26	20 6	19 45	19 22	19 1	18 38	18 17	17 55
γ Crux	21 53	21 34	21 12	20 53	20 31	20 10	19 49	19 27	19 6	18 43	18 21	17 59
SPICA.....	22 47	22 27	22 7	21 46	21 26	21 4	20 43	20 21	20 0	19 37	19 15	18 54
Benetnach .	23 12	22 52	22 32	22 11	21 50	21 29	21 8	20 46	20 24	20 2	19 40	19 17
β Centaur ...	23 22	23 2	22 42	22 22	22 1	21 40	21 18	20 57	20 35	20 13	19 50	19 28
α Draco.....	23 30	23 11	22 51	22 30	22 9	21 48	21 27	21 5	20 43	20 21	19 59	19 37
Arcturus ..	23 38	23 19	22 59	22 38	22 17	21 56	21 35	21 13	20 51	20 29	20 7	19 44
Seginus ...	23 56	23 36	23 16	22 55	22 35	22 13	21 52	21 30	21 8	20 46	20 24	20 2
α Centaur...	0 3	23 39	23 19	22 59	22 38	22 17	21 55	21 33	21 12	20 49	20 27	20 5
Zubenesch .	0 16	23 54	23 32	23 11	22 51	22 29	22 8	21 46	21 24	21 2	20 40	20 18
Zubenelg ..	0 42	0 23	0 2	23 38	23 17	22 56	22 35	22 13	21 51	21 29	21 7	20 44
Alphacca ..	1 2	0 42	0 22	23 58	23 37	23 16	22 54	22 33	22 11	21 48	21 26	21 4
α Serpens ...	1 10	0 51	0 31	0 10	23 45	23 24	23 3	22 41	22 19	21 57	21 35	21 12
ANTARES ..	1 53	1 34	1 13	0 53	0 32	0 11	23 46	23 24	23 2	22 40	22 18	21 55
Ras Algethi	2 41	2 22	2 2	1 41	1 20	0 59	0 38	0 16	23 50	23 28	23 6	22 43
Ras Alhague	3 2	2 42	2 22	2 1	1 40	1 19	0 58	0 36	0 14	23 48	23 26	23 4
Rastaban ..	3 26	3 8	2 48	2 27	2 6	1 45	1 24	1 2	0 40	0 18	23 52	23 29
Vega	4 5	3 45	3 25	3 5	2 45	2 23	2 2	1 40	1 18	0 56	0 34	0 12
α AQUILÆ ...	5 16	4 56	4 36	4 16	3 55	3 34	3 12	2 51	2 30	2 7	1 45	1 23
α Pavo	5 45	5 26	5 5	4 45	4 24	4 3	3 42	3 20	2 58	2 37	2 15	1 52
Deneb.....	6 9	5 49	5 29	5 9	4 48	4 27	4 5	3 44	3 22	3 0	2 39	2 16
Alderaimin.	6 48	6 28	6 8	5 48	5 27	5 6	4 44	4 23	4 1	3 39	3 16	2 54
α Aquarius..	7 30	7 11	6 51	6 30	6 9	5 48	5 27	5 5	4 43	4 21	3 59	3 37
α Grux	7 31	7 11	6 51	6 30	6 10	5 48	5 27	5 5	4 43	4 21	3 59	3 37
FOMALHAUT	8 22	8 2	7 42	7 21	7 0	6 39	6 18	5 56	5 34	5 12	4 50	4 28
Scheat	8 29	8 9	7 49	7 29	7 8	6 47	6 25	6 3	5 42	5 19	4 57	4 35
MARCAB...	8 30	8 10	7 50	7 29	7 9	6 47	6 26	6 4	5 42	5 20	4 58	4 36
Alpheratz..	9 32	9 12	8 53	8 33	8 12	7 51	7 29	7 8	6 46	6 24	6 0	5 39

TABLE XLV.

For finding the Time most advantageous for observing the Altitude of a celestial Object, in order to ascertain the Apparent Time.

Lat.	Declination of the same name with the Latitude.												
	0°	2°	4°	6°	8°	10°	12°	14°	16°	18°	20°	22°	24°
°	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
0	6 0	6 0	6 0	6 0	6 0	6 6	6 0	6 0	6 0	6 0	6 0	6 0	6 0
1	6 0	4 0	5 2	5 22	5 31	5 37	5 41	5 44	5 46	5 48	5 49	5 50	5 51
2	6 0	0 0	4 0	4 42	5 2	5 14	5 22	5 28	5 32	5 35	5 38	5 40	5 42
3	6 0	3 13	2 46	4 0	4 32	4 51	5 3	5 11	5 18	5 23	5 27	5 30	5 33
4	6 0	4 0	0 0	3 13	4 1	4 27	4 43	4 55	5 4	5 10	5 16	5 20	5 24
5	6 0	4 26	2 28	2 15	3 26	4 1	4 23	4 38	4 49	4 58	5 4	5 10	5 15
6	6 0	4 42	3 13	0 0	2 46	3 34	4 1	4 20	4 31	4 45	4 53	5 0	5 5
7	6 0	4 54	3 41	2 5	1 56	3 3	3 39	4 2	4 19	4 31	4 41	4 49	4 56
8	6 0	5 2	4 1	2 46	0 0	2 29	3 14	3 43	4 3	4 17	4 29	4 39	4 46
9	6 0	5 9	4 15	3 14	1 50	1 41	2 47	3 22	3 46	4 3	4 17	4 28	4 37
10	6 0	5 14	4 27	3 34	2 29	0 0	2 16	3 0	3 28	3 49	4 4	4 16	4 27
11	6 0	5 19	4 36	3 49	2 55	1 40	1 35	2 35	3 9	3 33	3 51	4 5	4 16
12	6 0	5 22	4 43	4 1	3 14	2 16	0 0	2 6	2 49	3 17	3 37	3 53	4 6
13	6 0	5 25	4 49	4 12	3 30	2 41	1 32	1 29	2 26	2 59	3 23	3 41	3 55
14	6 0	5 28	4 55	4 20	3 43	3 0	2 6	0 0	1 58	2 40	3 7	3 28	3 44
15	6 0	5 30	4 59	4 28	3 53	3 15	2 30	1 26	1 23	2 18	2 50	3 14	3 32
16	6 0	5 32	5 4	4 34	4 3	3 28	2 49	1 58	0 0	1 52	2 32	2 59	3 20
17	6 0	5 34	5 7	4 40	4 11	3 39	3 4	2 21	1 21	1 19	2 11	2 43	3 7
18	6 0	5 35	5 10	4 45	4 17	3 49	3 17	2 40	1 52	0 0	1 47	2 26	2 53
19	6 0	5 37	5 13	4 49	4 24	3 57	3 28	2 54	2 14	1 17	1 16	2 6	2 37
20	6 0	5 38	5 16	4 53	4 29	4 4	3 37	3 7	2 32	1 47	0 0	1 43	2 21
21	6 0	5 39	5 18	4 56	4 34	4 11	3 46	3 18	2 47	2 9	1 14	1 13	2 2
22	6 0	5 40	5 20	5 0	4 39	4 16	3 53	3 28	2 59	2 26	1 43	0 0	1 39
23	6 0	5 41	5 22	5 3	4 43	4 22	4 0	3 36	3 10	2 40	2 4	1 11	1 10
24	6 0	5 42	5 24	5 5	4 46	4 27	4 6	3 44	3 20	2 53	2 21	1 39	0 0
25	6 0	5 43	5 26	5 8	4 50	4 31	4 12	3 51	3 28	3 3	2 35	2 0	1 9
26	6 0	5 44	5 27	5 10	4 53	4 35	4 17	3 57	3 36	3 13	2 47	2 16	1 36
27	6 0	5 44	5 28	5 12	4 56	4 39	4 21	4 3	3 43	3 22	3 0	2 30	1 56
28	6 0	5 45	5 30	5 14	4 59	4 43	4 26	4 8	3 49	3 29	3 7	2 42	2 13
29	6 0	5 46	5 31	5 16	5 1	4 46	4 30	4 13	3 55	3 36	3 16	2 53	2 26
30	6 0	5 46	5 32	5 18	5 4	4 49	4 34	4 18	4 1	3 43	3 24	3 2	2 38
31	6 0	5 47	5 33	5 20	5 6	4 52	4 37	4 22	4 6	3 49	3 31	3 11	2 49
32	6 0	5 47	5 34	5 21	5 8	4 54	4 40	4 26	4 11	3 55	3 38	3 19	2 58
33	6 0	5 48	5 35	5 23	5 10	4 57	4 44	4 30	4 15	4 0	3 44	3 26	3 7
34	6 0	5 48	5 36	5 24	5 12	4 59	4 47	4 33	4 19	4 5	3 49	3 33	3 15
35	6 0	5 49	5 37	5 25	5 14	5 2	4 49	4 37	4 23	4 9	3 55	3 39	3 22
36	6 0	5 49	5 38	5 27	5 15	5 4	4 52	4 40	4 27	4 14	4 0	3 45	3 29
37	6 0	5 49	5 39	5 28	5 17	5 6	4 54	4 43	4 31	4 18	4 4	3 50	3 35
38	6 0	5 50	5 39	5 29	5 19	5 8	4 57	4 46	4 31	4 22	4 9	3 55	3 41
39	6 0	5 50	5 40	5 30	5 20	5 10	4 59	4 48	4 37	4 25	4 13	4 0	3 47
40	6 0	5 50	5 41	5 31	5 21	5 11	5 1	4 51	4 40	4 29	4 17	4 5	3 52
41	6 0	5 51	5 42	5 32	5 23	5 13	5 3	4 53	4 43	4 32	4 21	4 9	3 57
42	6 0	5 51	5 42	5 33	5 24	5 15	5 5	4 56	4 46	4 35	4 25	4 13	4 1
43	6 0	5 51	5 43	5 34	5 25	5 16	5 7	4 58	4 48	4 38	4 28	4 17	4 6
44	6 0	5 52	5 43	5 35	5 27	5 18	5 9	5 0	4 51	4 41	4 31	4 21	4 10
45	6 0	5 52	5 44	5 36	5 28	5 19	5 11	5 2	4 53	4 44	4 35	4 25	4 14
46	6 0	5 52	5 45	5 37	5 29	5 21	5 13	5 4	4 56	4 47	4 38	4 28	4 18
47	6 0	5 53	5 45	5 38	5 30	5 22	5 14	5 6	4 58	4 49	4 41	4 31	4 22
48	6 0	5 53	5 46	5 38	5 31	5 23	5 16	5 8	5 0	4 52	4 43	4 35	4 25
49	6 0	5 53	5 46	5 39	5 32	5 25	5 17	5 10	5 2	4 54	4 46	4 38	4 29
50	6 0	5 53	5 47	5 40	5 33	5 26	5 19	5 12	5 4	4 57	4 49	4 41	4 32
52	6 0	5 54	5 47	5 41	5 35	5 28	5 22	5 15	5 8	5 1	4 54	4 46	4 39
54	6 0	5 54	5 48	5 42	5 37	5 31	5 24	5 18	5 12	5 5	4 59	4 52	4 45
56	6 0	5 55	5 49	5 44	5 36	5 33	5 27	5 21	5 15	5 9	5 3	4 57	4 50
58	6 0	5 55	5 50	5 45	5 40	5 35	5 29	5 24	5 19	5 13	5 7	5 2	4 55
60	6 0	5 55	5 51	5 46	5 41	5 37	5 32	5 27	5 22	5 17	5 11	5 6	5 0
62	6 0	5 56	5 51	5 47	5 43	5 38	5 34	5 30	5 25	5 20	5 15	5 10	5 5
64	6 0	5 56	5 52	5 48	5 44	5 40	5 36	5 32	5 28	5 24	5 19	5 15	5 10
66	6 0	5 56	5 53	5 49	5 46	5 42	5 38	5 35	5 31	5 27	5 23	5 19	5 14
68	6 0	5 57	5 54	5 50	5 47	5 44	5 40	5 37	5 33	5 30	5 26	5 22	5 19
70	6 0	5 57	5 54	5 51	5 48	5 45	5 42	5 39	5 36	5 33	5 30	5 26	5 23

TABLE XLV.

For finding the TIME most advantageous for observing the Altitude of a celestial Object, in order to ascertain the Apparent Time.

Lat.	Declination of the same name with the Latitude.												
	26°	28°	30°	32°	34°	36°	38°	40°	42°	44°	46°	48°	50°
°	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0	6 0
1	5 52	5 52	5 53	5 54	5 54	5 54	5 55	5 55	5 56	5 56	5 56	5 56	5 57
2	5 44	5 45	5 46	5 47	5 48	5 49	5 50	5 50	5 51	5 52	5 52	5 53	5 53
3	5 35	5 37	5 39	5 41	5 42	5 43	5 45	5 46	5 47	5 48	5 48	5 49	5 50
4	5 27	5 30	5 32	5 34	5 36	5 38	5 39	5 41	5 42	5 43	5 45	5 46	5 47
5	5 19	5 22	5 25	5 28	5 30	5 32	5 34	5 36	5 38	5 39	5 41	5 42	5 43
6	5 10	5 14	5 18	5 21	5 24	5 27	5 29	5 31	5 33	5 35	5 37	5 38	5 40
7	5 2	5 7	5 11	5 15	5 18	5 21	5 24	5 26	5 29	5 31	5 33	5 35	5 36
8	4 53	4 59	5 4	5 8	5 12	5 15	5 19	5 21	5 21	5 27	5 29	5 31	5 33
9	4 44	4 51	4 56	5 1	5 6	5 10	5 13	5 16	5 19	5 22	5 25	5 27	5 29
10	4 35	4 43	4 49	4 54	4 59	5 4	5 8	5 11	5 15	5 18	5 21	5 23	5 26
11	4 26	4 34	4 41	4 48	4 53	4 58	5 2	5 6	5 10	5 14	5 17	5 20	5 22
12	4 17	4 26	4 34	4 40	4 47	4 52	4 57	5 1	5 5	5 9	5 13	5 16	5 19
13	4 7	4 17	4 26	4 33	4 40	4 46	4 51	4 56	5 1	5 5	5 8	5 12	5 15
14	3 57	4 8	4 18	4 26	4 33	4 40	4 46	4 51	4 56	5 0	5 4	5 8	5 12
15	3 47	3 59	4 9	4 18	4 26	4 33	4 40	4 46	4 51	4 56	5 0	5 4	5 8
16	3 36	3 49	4 1	4 11	4 19	4 27	4 34	4 40	4 46	4 51	4 56	5 0	5 4
17	3 25	3 40	3 52	4 3	4 12	4 20	4 28	4 35	4 41	4 46	4 51	4 56	5 1
18	3 13	3 29	3 43	3 55	4 5	4 14	4 22	4 29	4 35	4 41	4 47	4 52	4 57
19	3 0	3 19	3 34	3 46	3 57	4 7	4 15	4 23	4 30	4 36	4 42	4 48	4 53
20	2 47	3 7	3 24	3 38	3 49	4 0	4 9	4 17	4 25	4 31	4 38	4 43	4 49
21	2 32	2 55	3 13	3 28	3 41	3 52	4 2	4 11	4 19	4 26	4 33	4 39	4 45
22	2 16	2 42	3 2	3 19	3 33	3 45	3 55	4 5	4 13	4 21	4 28	4 35	4 41
23	1 58	2 28	2 51	3 9	3 24	3 37	3 48	3 58	4 7	4 16	4 23	4 30	4 37
24	1 36	2 13	2 38	2 58	3 15	3 29	3 41	3 52	4 1	4 10	4 18	4 25	4 32
25	1 8	1 55	2 25	2 47	3 5	3 20	3 33	3 45	3 55	4 5	4 13	4 21	4 28
26	0 0	1 31	2 9	2 35	2 55	3 11	3 25	3 38	3 49	3 59	4 8	4 16	4 23
27	1 7	1 6	1 52	2 21	2 44	3 2	3 17	3 30	3 42	3 53	4 2	4 11	4 19
28	1 34	0 0	1 32	2 7	2 32	2 52	3 8	3 23	3 35	3 46	3 56	4 6	4 14
29	1 53	1 6	1 5	1 50	2 19	2 41	2 59	3 15	3 28	3 40	3 50	4 0	4 9
30	2 9	1 32	0 0	1 30	2 5	2 30	2 49	3 6	3 20	3 33	3 44	3 55	4 4
31	2 23	1 51	1 4	1 4	1 48	2 17	2 39	2 57	3 13	3 26	3 38	3 49	3 59
32	2 35	2 7	1 30	0 0	1 28	2 3	2 28	2 47	3 4	3 19	3 32	3 43	3 54
33	2 45	2 20	1 49	1 3	1 3	1 47	2 15	2 37	2 55	3 11	3 25	3 37	3 48
34	2 55	2 32	2 5	1 28	0 0	1 27	2 1	2 26	2 46	3 3	3 17	3 30	3 42
35	3 3	2 42	2 18	1 47	1 2	1 2	1 45	2 14	2 36	2 54	3 10	3 24	3 36
36	3 11	2 52	2 30	2 3	1 27	0 0	1 26	2 0	2 25	2 45	3 2	3 17	3 30
37	3 19	3 0	2 40	2 16	1 4[illegible]	1 2	1 1	1 44	2 13	2 35	2 53	3 9	3 23
38	3 25	3 8	2 49	2 28	2 1	1 26	0 0	1 26	1 59	2 24	2 44	3 1	3 16
39	3 32	3 16	2 58	2 38	2 14	1 45	1 1	1 1	1 44	2 12	2 34	2 53	3 9
40	3 38	3 23	3 6	2 47	2 26	2 0	1 26	0 0	1 25	1 59	2 23	2 44	3 1
41	3 43	3 29	3 14	2 56	2 36	2 13	1 41	1 1	1 0	1 43	2 12	2 34	2 53
42	3 49	3 35	3 20	3 4	2 46	2 25	1 59	1 25	0 0	1 25	1 58	2 23	2 44
43	3 54	3 41	3 27	3 12	2 55	2 35	2 12	1 43	1 0	1 0	1 43	2 12	2 34
44	3 59	3 46	3 33	3 19	3 4	2 45	2 21	1 59	1 25	0 0	1 25	1 58	2 23
45	4 3	3 52	3 39	3 25	3 10	2 54	2 34	2 12	1 43	1 0	1 0	1 43	2 12
46	4 8	3 56	3 44	3 32	3 17	3 2	2 44	2 23	1 58	1 25	0 0	1 25	1 59
47	4 12	4 1	3 50	3 37	3 24	3 9	2 53	2 34	2 12	1 43	1 0	1 0	1 43
48	4 16	4 6	3 55	3 43	3 30	3 17	3 1	2 44	2 23	1 58	1 25	0 0	1 25
49	4 20	4 10	4 0	3 48	3 36	3 23	3 9	2 53	2 34	2 12	1 43	1 0	1 0
50	4 23	4 14	4 4	3 54	3 42	3 30	3 16	3 1	2 44	2 23	1 59	1 25	0 0
52	4 30	4 22	4 13	4 3	3 53	3 42	3 30	3 16	3 1	2 44	2 24	1 59	1 26
54	4 37	29	4 21	4 12	4 3	3 53	3 42	3 30	3 17	3 2	2 45	2 25	2 0
56	4 43	4 36	4 28	4 20	4 12	4 3	3 53	3 42	3 30	3 17	3 3	2 46	2 26
58	4 49	42	4 35	4 28	4 20	4 12	4 3	3 54	3 43	3 32	3 19	3 4	2 47
60	4 55	4 48	4 42	4 35	4 28	4 21	4 13	4 4	3 55	3 44	3 33	3 20	3 6
62	5 0	4 54	4 48	4 42	4 36	4 29	4 22	4 14	4 6	3 56	3 46	3 35	3 23
64	5 5	5 0	4 55	4 49	4 43	4 37	4 30	4 23	4 16	4 8	3 59	3 49	3 38
66	5 10	5 5	5 0	4 55	4 50	4 45	4 39	4 32	4 25	4 18	4 10	4 1	3 52
68	5 15	10	5 6	5 2	4 57	4 52	4 46	4 41	4 35	4 28	4 21	4 13	4 5
70	5 19	5 15	5 11	5 7	5 3	4 59	4 54	4 49	4 43	4 38	4 31	4 22	4 17

TABLE XLVI.

For finding the ALTITUDE of a celestial Object most advantageous for ascertaining the Apparent Time.

Lat.	Declination of the same name with the Latitude.																									
	0°		2°		4°		6°		8°		10°		12°		14°		16°		18°		20°		22°		24°	
°	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°		°	′
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	30	0	14	29	9	37	7	12	5	46	4	49	4	8	3	38	3	14	2	55	2	40	2	28
2	0	0	90	0	30	1	19	30	14	31	11	36	9	40	8	18	7	16	6	29	5	51	5	21	4	55
3	0	0	41	49	48	37	30	3	22	5	17	32	14	35	12	30	10	57	9	45	8	48	8	2	7	24
4	0	0	30	1	90	0	41	52	30	5	23	41	19	36	16	45	14	40	13	3	11	46	10	44	9	53
5	0	0	23	36	53	10	56	30	38	46	30	8	24	47	21	7	18	26	16	23	14	46	13	27	12	22
6	0	0	19	30	41	52	90	0	48	41	37	1	30	11	25	36	22	17	19	46	17	48	16	12	14	53
7	0	0	16	38	34	55	59	4	61	7	44	34	35	53	30	15	26	14	23	14	20	52	18	59	17	26
8	0	0	14	31	30	5	48	41	90	0	53	16	42	1	35	7	30	20	26	46	24	1	21	49	20	1
9	0	0	12	53	26	29	41	56	62	50	64	16	48	48	40	17	34	35	30	25	27	13	24	41	22	37
10	0	0	11	36	23	41	37	1	53	16	90	0	56	38	45	52	39	3	34	11	30	31	27	37	25	16
11	0	0	10	32	21	27	33	13	46	50	65	31	66	36	52	4	43	48	38	8	33	55	30	37	27	59
12	0	0	9	40	19	36	30	11	42	1	56	38	90	0	59	15	48	58	42	17	37	26	33	43	30	45
13	0	0	8	56	18	4	27	41	38	13	50	32	67	33	68	25	54	42	46	43	41	8	36	54	33	35
14	0	0	8	18	16	45	25	36	35	7	45	52	59	15	90	0	61	22	51	32	45	1	40	14	36	30
15	0	0	7	45	15	38	23	49	32	32	42	8	53	27	69	11	69	53	56	53	49	11	43	42	39	31
16	0	0	7	16	14	40	22	17	30	20	39	3	48	58	61	22	90	0	63	7	53	42	47	22	42	40
17	0	0	6	51	13	48	20	57	28	26	36	26	45	20	55	50	70	31	71	7	58	45	51	18	45	57
18	0	0	6	29	13	3	19	46	26	46	34	11	42	17	51	32	63	7	90	0	64	37	55	35	49	27
19	0	0	6	9	12	22	18	41	25	18	32	14	39	41	48	0	57	51	71	39	72	9	60	21	53	10
20	0	0	5	51	11	46	17	48	24	1	30	31	37	26	45	1	53	42	64	37	90	0	65	55	57	14
21	0	0	5	35	11	13	16	57	22	51	28	59	35	28	42	28	50	17	59	34	72	38	73	4	61	47
22	0	0	5	21	10	44	16	12	21	49	27	37	33	43	40	14	47	22	55	35	65	55	90	0	67	5
23	0	0	5	7	10	17	15	31	20	52	26	23	32	9	38	15	44	52	52	16	61	5	73	29	73	53
24	0	0	4	55	9	53	14	53	20	1	25	16	30	45	36	30	42	40	49	27	57	14	67	5	90	0
25	0	0	4	44	9	30	14	19	19	14	24	16	29	28	34	55	40	43	46	59	54	1	62	25	74	16
26	0	0	4	34	9	9	13	48	18	31	23	20	28	19	33	30	38	58	44	49	51	17	58	43	68	5
27	0	0	4	25	8	50	13	19	17	51	22	29	27	15	32	12	37	23	42	54	48	53	55	36	63	37
28	0	0	4	16	8	33	12	52	17	15	21	42	26	17	31	1	35	57	41	10	46	46	52	56	60	3
29	0	0	4	8	8	16	12	27	16	41	20	59	25	24	29	56	34	39	39	36	44	52	50	36	57	2
30	0	0	4	0	8	1	12	4	16	10	20	19	24	34	28	56	33	27	38	10	43	10	48	31	54	26
31	0	0	3	53	7	47	11	43	15	41	19	42	23	49	28	1	32	21	36	52	41	37	46	40	52	10
32	0	0	3	47	7	34	11	23	15	14	19	8	23	6	27	10	31	21	35	40	40	12	44	59	50	9
33	0	0	3	40	7	22	11	4	14	48	18	36	22	26	26	22	30	24	34	34	38	54	43	27	48	18
34	0	0	3	35	7	10	10	46	14	25	18	5	21	50	25	38	29	32	33	33	37	42	42	4	46	39
35	0	0	3	29	6	59	10	30	14	3	17	37	21	15	24	57	28	43	32	36	36	36	40	47	45	11
36	0	0	3	24	6	49	10	16	13	42	17	11	20	43	24	18	27	58	31	4	35	35	39	36	43	46
37	0	0	3	19	6	39	10	0	13	22	16	46	20	13	23	42	27	16	30	54	34	38	38	30	42	31
38	0	0	3	15	6	31	9	47	13	4	16	23	19	44	23	8	26	36	30	8	33	45	37	29	41	20
39	0	0	3	11	6	22	9	34	12	47	16	1	19	18	22	36	25	59	29	25	32	55	36	32	40	16
40	0	0	3	7	6	14	9	22	12	30	15	40	18	52	22	7	25	24	28	44	32	9	35	39	39	15
41	0	0	3	3	6	6	9	10	12	15	15	21	18	29	21	38	24	51	28	6	31	25	34	49	38	18
42	0	0	2	59	5	59	8	59	12	0	15	2	18	6	21	12	24	20	27	30	30	41	34	3	37	25
43	0	0	2	56	5	52	8	49	11	47	14	45	17	45	20	47	23	50	26	57	30	6	33	19	36	36
44	0	0	2	53	5	46	8	39	11	33	14	29	17	25	20	23	23	23	26	25	29	30	32	38	35	49
45	0	0	2	50	5	40	8	30	11	21	14	13	17	6	20	0	22	57	25	55	28	56	31	59	35	6
46	0	0	2	47	5	34	8	21	11	9	13	58	16	48	19	39	22	32	25	26	28	23	31	25	34	25
47	0	0	2	44	5	28	8	13	10	58	13	41	16	31	19	19	22	8	25	0	27	53	30	49	33	47
48	0	0	2	42	5	23	8	5	10	48	13	31	16	15	19	0	21	46	24	34	27	21	30	16	33	12
49	0	0	2	39	5	18	7	58	10	38	13	18	15	59	18	42	21	25	24	10	26	57	29	46	32	35
50	0	0	2	37	5	13	7	51	10	28	13	6	15	45	18	25	21	5	23	47	26	31	29	17	32	4
52	0	0	2	32	5	5	7	37	10	10	12	44	15	18	17	53	20	28	23	5	25	43	28	23	31	7
54	0	0	2	28	4	57	7	25	9	54	12	24	14	54	17	21	19	55	22	27	25	1	27	35	30	10
56	0	0	2	25	4	50	7	15	9	40	12	5	14	31	16	58	19	25	21	53	24	22	26	52	29	22
58	0	0	2	22	4	43	7	5	9	27	11	49	14	11	16	35	18	58	21	22	23	47	26	13	28	39
60	0	0	2	19	4	37	6	56	9	15	11	34	13	53	16	13	18	34	20	54	23	16	25	38	28	0
62	0	0	2	16	4	31	6	47	9	3	11	19	13	3	15	54	18	12	20	29	22	43	25	6	27	26
64	0	0	2	14	4	27	6	41	8	54	11	8	13	23	15	37	17	52	20	7	22	22	24	38	26	54
66	0	0	2	11	4	23	6	34	8	46	10	57	13	9	15	21	17	34	19	46	21	59	24	13	26	26
68	0	0	2	9	4	19	6	28	8	38	10	48	12	57	15	7	17	18	19	28	21	39	23	50	26	1
70	0	0	2	8	4	15	6	23	8	31	10	39	12	47	14	55	17	3	19	12	21	21	23	30	25	39

For finding the ALTITUDE of a celestial Object most advantageous for ascertaining the Apparent Time.

Lat.	Declination of the same name with the Latitude.																									
	26°		28°		30°		32°		34°		36°		38°		40°		42°		44°		46°		48°		50°	
°	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′	°	′
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	2	17	2	8	2	0	1	53	1	47	1	42	1	37	1	33	1	30	1	26	1	23	1	21	1	18
2	4	34	4	16	4	0	3	47	3	35	3	24	3	15	3	7	2	59	2	53	2	47	2	42	2	37
3	6	51	6	21	6	0	5	40	5	22	5	6	4	53	4	40	4	29	4	19	4	10	4	2	3	55
4	9	9	8	33	8	1	7	34	7	10	6	49	6	31	6	14	5	59	5	46	5	34	5	23	5	13
5	11	28	10	42	10	2	9	28	8	58	8	32	8	8	7	48	7	29	7	12	6	58	6	44	6	32
6	13	48	12	52	12	4	11	23	10	46	10	16	9	47	9	22	8	59	8	39	8	21	8	5	7	51
7	16	8	15	3	14	6	13	18	12	35	11	58	11	25	10	56	10	30	10	6	9	45	9	26	9	9
8	18	31	17	15	16	10	15	14	14	25	13	42	13	4	12	30	12	0	11	33	11	9	10	48	10	28
9	20	54	19	28	18	14	17	10	16	15	15	26	14	43	14	5	13	31	13	1	12	34	12	9	11	47
10	23	20	21	42	20	19	19	8	18	5	17	11	16	23	15	40	15	2	14	29	13	58	13	31	13	6
11	25	48	23	59	22	26	21	6	19	57	18	57	18	3	17	16	16	34	15	57	15	23	14	53	14	25
12	28	19	26	17	24	34	23	6	21	50	20	43	19	44	18	52	18	6	17	25	16	48	16	15	15	45
13	30	52	28	38	26	44	25	7	23	43	22	30	21	26	20	29	19	39	18	54	18	13	17	37	17	5
14	33	30	31	1	28	56	27	10	25	38	24	18	23	8	22	7	21	12	20	23	19	39	19	0	18	25
15	36	11	33	27	31	10	29	14	27	34	26	8	24	52	23	45	22	45	21	53	21	5	20	23	19	5
16	38	58	35	57	33	27	31	21	29	32	27	58	26	36	25	24	24	20	23	23	22	32	21	46	21	5
17	41	50	38	31	35	47	33	29	31	31	29	50	28	21	27	3	25	55	24	53	23	59	23	10	22	2
18	44	49	41	10	38	10	35	40	33	33	31	43	30	8	28	44	27	30	26	25	25	26	24	34	23	47
19	47	58	43	54	40	38	37	54	35	36	33	38	31	56	30	26	29	7	27	57	26	55	25	59	25	9
20	51	17	46	46	43	10	40	12	37	42	35	35	33	45	32	9	30	44	29	30	28	23	27	24	26	31
21	54	50	49	46	45	47	42	33	39	51	37	31	35	36	33	53	32	23	31	3	29	53	28	50	27	54
22	58	43	52	56	48	31	44	59	42	4	39	36	37	29	35	39	34	3	32	38	31	23	30	16	29	17
23	63	2	56	20	51	24	47	30	44	20	41	40	39	24	37	26	35	44	34	14	32	54	31	43	30	40
24	68	6	60	2	54	26	50	8	46	40	43	47	41	21	39	15	37	26	35	50	34	26	33	11	32	4
25	74	36	64	11	57	42	52	54	49	6	45	58	43	21	41	6	39	10	37	28	35	59	34	40	33	29
26	90	0	69	2	61	15	55	49	51	37	48	14	45	24	43	0	40	56	39	8	37	33	36	9	34	54
27	74	56	75	15	65	14	58	57	54	17	50	34	47	31	44	56	42	44	40	49	39	8	37	39	36	21
28	69	2	90	0	69	52	62	22	57	6	53	0	49	41	46	55	44	33	42	31	40	45	39	11	37	48
29	64	43	75	33	75	50	66	11	60	7	55	34	51	57	48	57	46	26	14	16	42	22	40	43	39	16
30	61	15	69	52	90	0	70	39	63	24	58	17	54	18	51	4	48	21	46	2	44	2	42	17	40	45
31	58	20	65	43	76	7	76	23	67	5	61	11	56	47	53	15	50	20	47	51	45	43	43	52	42	15
32	55	49	62	22	70	39	90	0	71	23	64	22	59	24	55	32	52	22	49	43	47	27	15	29	43	46
33	53	36	59	32	66	38	76	39	76	54	67	55	62	12	57	55	54	29	51	38	49	13	47	8	45	19
34	51	37	57	6	63	24	71	23	90	0	72	3	65	16	60	27	56	41	53	37	51	1	43	48	46	53
35	49	51	54	56	60	40	67	30	77	8	77	22	68	42	63	10	59	0	55	40	52	53	50	31	48	29
36	48	14	53	0	58	17	64	22	72	3	90	0	72	42	66	8	61	27	57	48	54	48	52	16	50	7
37	46	45	51	16	56	11	61	42	68	18	77	36	77	49	69	26	64	5	60	2	56	47	54	5	51	47
38	45	24	49	41	54	18	59	24	65	16	72	42	90	0	73	18	66	56	62	25	58	51	55	56	53	29
39	44	9	48	15	52	37	57	24	62	42	69	4	78	2	78	15	70	8	64	57	61	2	57	52	55	14
40	43	0	46	55	51	4	55	32	60	27	66	8	73	18	90	0	73	52	67	43	63	20	59	53	57	3
41	41	56	45	42	49	39	53	53	58	28	63	38	69	47	78	28	78	39	70	49	65	47	61	59	58	55
42	40	56	44	33	48	21	52	22	56	41	61	27	66	56	73	52	90	0	74	25	68	28	64	13	60	52
43	40	0	43	30	47	9	50	59	55	5	59	32	64	31	70	29	78	51	79	3	71	27	66	36	62	55
44	39	8	42	31	46	2	49	43	53	37	57	48	62	25	67	43	74	25	90	0	74	57	69	11	65	4
45	38	19	41	36	45	0	48	32	52	16	56	14	60	32	65	22	71	8	79	14	79	25	72	5	67	23
46	37	33	40	45	44	2	47	27	51	1	54	48	58	51	63	20	68	28	74	57	90	0	75	28	69	53
47	36	50	39	56	43	8	46	26	49	52	53	29	57	20	61	31	66	12	71	46	79	36	79	47	72	42
48	36	9	39	11	42	17	45	29	48	48	52	16	55	56	59	53	64	13	69	11	75	28	90	0	75	57
49	35	31	38	28	41	29	44	36	47	49	51	9	54	40	58	21	62	27	66	59	72	23	79	57	80	8
50	34	54	37	48	40	45	43	46	46	53	50	7	53	29	57	3	60	52	65	4	69	53	75	57	90	0
52	33	48	36	54	39	23	42	16	45	12	18	11	51	23	54	40	58	7	61	50	65	54	70	34	76	25
54	32	49	35	28	38	10	40	55	43	43	46	36	49	33	52	37	55	48	59	16	62	46	66	43	71	14
56	31	55	34	39	37	6	39	44	42	25	15	9	47	57	50	50	53	49	56	55	60	11	63	41	67	31
58	31	8	33	37	36	8	38	40	41	15	43	53	46	33	49	17	52	6	55	0	58	1	61	12	64	36
60	30	25	32	50	35	16	37	44	40	13	12	45	15	19	47	55	50	36	53	20	56	10	59	6	62	12
62	29	46	32	7	34	30	36	53	39	18	41	44	44	13	46	43	49	17	51	53	54	32	57	19	60	11
64	29	11	31	30	33	48	36	8	38	28	40	51	43	14	45	40	48	7	50	37	53	10	55	47	58	28
66	28	41	30	55	33	11	35	27	37	45	40	3	42	22	44	43	47	6	49	30	51	57	54	26	56	59
68	28	13	30	26	32	38	34	51	37	6	39	20	41	36	43	53	46	12	48	31	50	53	53	16	55	43
70	27	48	29	59	32	9	34	20	36	31	38	43	40	56	43	10	45	24	47	40	49	57	52	16	54	36

TABLE XLVII.

Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.

Sec. or ″	MINUTES OF AN HOUR OR A DEGREE.											Sec. or ″
	0	1	2	3	4	5	6	7	8	9	10	11	
0		1.7782	1.4771	1.3010	1.1761	1.0792	0000	9331	8751	8239	7782	7368	0
1	3.5563	1.7710	1.4735	1.2986	1.1743	1.0777	9988	9320	8742	8231	7774	7361	1
2	3.2553	1.7639	1.4699	1.2962	1.1725	1.0763	9976	9310	8733	8223	7767	7354	2
3	3.0792	1.7570	1.4664	1.2939	1.1707	1.0749	9964	9300	8724	8215	7760	7348	3
4	2.9542	1.7501	1.4629	1.2915	1.1689	1.0734	9952	9289	8715	8207	7753	7341	4
5	2.8573	1.7434	1.4594	1.2891	1.1671	1.0720	9940	9279	8706	8199	7745	7335	5
6	2.7782	1.7368	1.4559	1.2868	1.1654	1.0706	9928	9269	8697	8191	7738	7328	6
7	2.7112	1.7302	1.4525	1.2845	1.1636	1.0692	9916	9259	8688	8183	7731	7322	7
8	2.6532	1.7238	1.4491	1.2821	1.1619	1.0678	9905	9249	8679	8175	7724	7315	8
9	2.6021	1.7175	1.4457	1.2798	1.1601	1.0663	9893	9238	8670	8167	7717	7309	9
10	2.5563	1.7112	1.4424	1.2775	1.1584	1.0649	9881	9228	8661	8159	7710	7302	10
11	2.5149	1.7050	1.4390	1.2753	1.1566	1.0635	9869	9218	8652	8152	7703	7296	11
12	2.4771	1.6990	1.4357	1.2730	1.1549	1.0621	9858	9208	8643	8144	7696	7289	12
13	2.4424	1.6930	1.4325	1.2707	1.1532	1.0608	9846	9198	8635	8136	7688	7283	13
14	2.4102	1.6871	1.4292	1.2685	1.1515	1.0594	9834	9188	8626	8128	7681	7276	14
15	2.3802	1.6812	1.4260	1.2663	1.1498	1.0580	9823	9178	8617	8120	7674	7270	15
16	2.3522	1.6755	1.4228	1.2640	1.1481	1.0566	9811	9168	8608	8112	7667	7264	16
17	2.3259	1.6698	1.4196	1.2618	1.1464	1.0552	9800	9158	8599	8104	7660	7257	17
18	2.3010	1.6642	1.4165	1.2596	1.1447	1.0539	9788	9148	8591	8097	7653	7251	18
19	2.2775	1.6587	1.4133	1.2574	1.1430	1.0525	9777	9138	8582	8089	7646	7244	19
20	2.2553	1.6532	1.4102	1.2553	1.1413	1.0512	9765	9128	8573	8081	7639	7238	20
21	2.2341	1.6478	1.4071	1.2531	1.1397	1.0498	9754	9119	8565	8073	7632	7232	21
22	2.2139	1.6425	1.4040	1.2510	1.1380	1.0484	9742	9109	8556	8066	7625	7225	22
23	2.1946	1.6372	1.4010	1.2488	1.1363	1.0471	9731	9099	8547	8058	7618	7219	23
24	2.1761	1.6320	1.3979	1.2467	1.1347	1.0458	9720	9089	8539	8050	7611	7212	24
25	2.1584	1.6269	1.3949	1.2445	1.1331	1.0444	9708	9079	8530	8043	7604	7206	25
26	2.1413	1.6218	1.3919	1.2424	1.1314	1.0431	9697	9070	8522	8035	7597	7200	26
27	2.1249	1.6168	1.3890	1.2403	1.1298	1.0418	9686	9060	8513	8027	7590	7193	27
28	2.1091	1.6118	1.3860	1.2382	1.1282	1.0404	9675	9050	8504	8020	7583	7187	28
29	2.0939	1.6069	1.3831	1.2362	1.1266	1.0391	9664	9041	8496	8012	7577	7181	29
30	2.0792	1.6021	1.3802	1.2341	1.1249	1.0378	9652	9031	8487	8004	7570	7175	30
31	2.0649	1.5973	1.3773	1.2320	1.1233	1.0365	9641	9021	8479	7997	7563	7168	31
32	2.0512	1.5925	1.3745	1.2300	1.1217	1.0352	9630	9012	8470	7989	7556	7162	32
33	2.0378	1.5878	1.3716	1.2279	1.1201	1.0339	9619	9002	8462	7981	7549	7156	33
34	2.0248	1.5832	1.3688	1.2259	1.1186	1.0326	9608	8992	8453	7974	7542	7149	34
35	2.0122	1.5786	1.3660	1.2239	1.1170	1.0313	9597	8983	8445	7966	7535	7143	35
36	2.0000	1.5740	1.3632	1.2218	1.1154	1.0300	9586	8973	8437	7959	7528	7137	36
37	1.9881	1.5695	1.3604	1.2198	1.1138	1.0287	9575	8964	8428	7951	7522	7131	37
38	1.9765	1.5651	1.3576	1.2178	1.1123	1.0274	9564	8954	8420	7944	7515	7124	38
39	1.9652	1.5607	1.3549	1.2159	1.1107	1.0261	9553	8945	8411	7936	7508	7118	39
40	1.9542	1.5563	1.3522	1.2139	1.1091	1.0248	9542	8935	8403	7929	7501	7112	40
41	1.9435	1.5520	1.3495	1.2119	1.1076	1.0235	9532	8926	8395	7921	7494	7106	41
42	1.9331	1.5477	1.3468	1.2099	1.1061	1.0223	9521	8917	8386	7914	7488	7100	42
43	1.9228	1.5435	1.3441	1.2080	1.1045	1.0210	9510	8907	8378	7906	7481	7093	43
44	1.9128	1.5393	1.3415	1.2061	1.1030	1.0197	9499	8898	8370	7899	7474	7087	44
45	1.9031	1.5351	1.3388	1.2041	1.1015	1.0185	9488	8888	8361	7891	7467	7081	45
46	1.8935	1.5310	1.3362	1.2022	1.0999	1.0172	9478	8879	8353	7884	7461	7075	46
47	1.8842	1.5269	1.3336	1.2003	1.0984	1.0160	9467	8870	8345	7877	7454	7069	47
48	1.8751	1.5229	1.3310	1.1984	1.0969	1.0147	9456	8861	8337	7869	7447	7063	48
49	1.8661	1.5189	1.3284	1.1965	1.0954	1.0135	9446	8851	8328	7862	7441	7057	49
50	1.8573	1.5149	1.3259	1.1946	1.0939	1.0122	9435	8842	8320	7855	7434	7050	50
51	1.8487	1.5110	1.3233	1.1927	1.0924	1.0110	9425	8833	8312	7847	7427	7044	51
52	1.8403	1.5071	1.3208	1.1908	1.0909	1.0098	9414	8824	8304	7840	7421	7038	52
53	1.8320	1.5032	1.3183	1.1889	1.0894	1.0085	9404	8814	8296	7832	7414	7032	53
54	1.8239	1.4994	1.3158	1.1871	1.0880	1.0073	9393	8805	8288	7825	7407	7026	54
55	1.8159	1.4956	1.3133	1.1852	1.0865	1.0061	9383	8796	8279	7818	7401	7020	55
56	1.8081	1.4918	1.3108	1.1834	1.0850	1.0049	9372	8787	8271	7811	7394	7014	56
57	1.8004	1.4881	1.3083	1.1816	1.0835	1.0036	9362	8778	8263	7803	7387	7008	57
58	1.7929	1.4844	1.3059	1.1797	1.0821	1.0024	9351	8769	8255	7796	7381	7002	58
59	1.7855	1.4808	1.3034	1.1779	1.0806	1.0012	9341	8760	8247	7789	7374	6996	59
60	1.7782	1.4771	1.3010	1.1761	1.0792	1.0000	9331	8751	8239	7782	7368	6990	60

TABLE XLVII.

Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.

Sec. or ″	MINUTES OF AN HOUR OR A DEGREE.												Sec. or ″
	12	13	14	15	16	17	18	19	20	21	22	23	
0	6990	6642	6320	6021	5740	5477	5229	4994	4771	4559	4357	4164	0
1	6984	6637	6315	6016	5736	5473	5225	4990	4768	4556	4354	4161	1
2	6978	6631	6310	6011	5731	5469	5221	4986	4764	4552	4351	4158	2
3	6972	6625	6305	6006	5727	5464	5217	4983	4760	4549	4347	4155	3
4	6966	6620	6300	6001	5722	5460	5213	4979	4757	4546	4344	4152	4
5	6960	6614	6294	5997	5718	5456	5209	4975	4753	4542	4341	4149	5
6	6954	6609	6289	5992	5713	5452	5205	4971	4750	4539	4338	4145	6
7	6948	6603	6284	5987	5709	5447	5201	4967	4746	4535	4334	4142	7
8	6942	6598	6279	5982	5704	5443	5197	4964	4742	4532	4331	4139	8
9	6936	6592	6274	5977	5700	5439	5193	4960	4739	4528	4328	4136	9
10	6930	6587	6269	5973	5695	5435	5189	4956	4735	4525	4325	4133	10
11	6924	6581	6264	5968	5691	5430	5185	4952	4732	4522	4321	4130	11
12	6918	6576	6259	5963	5686	5426	5181	4949	4728	4518	4318	4127	12
13	6912	6570	6254	5958	5682	5422	5177	4945	4724	4515	4315	4124	13
14	6906	6565	6248	5954	5677	5418	5173	4941	4721	4511	4311	4120	14
15	6900	6559	6243	5949	5673	5414	5169	4937	4717	4508	4308	4117	15
16	6804	6554	6238	5944	5669	5409	5165	4933	4714	4505	4305	4114	16
17	6888	6548	6233	5939	5664	5405	5161	4930	4710	4501	4302	4111	17
18	6882	6543	6228	5935	5660	5401	5157	4926	4707	4498	4298	4108	18
19	6877	6538	6223	5930	5655	5397	5153	4922	4703	4494	4295	4105	19
20	6871	6532	6218	5925	5651	5393	5149	4918	4699	4491	4292	4102	20
21	6865	6527	6213	5920	5646	5389	5145	4915	4696	4488	4289	4099	21
22	6859	6521	6208	5916	5642	5384	5141	4911	4692	4484	4285	4096	22
23	6853	6516	6203	5911	5637	5380	5137	4907	4689	4481	4282	4092	23
24	6847	6510	6198	5906	5633	5376	5133	4903	4685	4477	4279	4089	24
25	6841	6505	6193	5902	5629	5372	5129	4900	4682	4474	4276	4086	25
26	6836	6500	6188	5897	5624	5368	5125	4896	4678	4471	4273	4083	26
27	6830	6494	6183	5892	5620	5364	5122	4892	4675	4467	4269	4080	27
28	6824	6489	6178	5888	5615	5359	5118	4889	4671	4464	4266	4077	28
29	6818	6484	6173	5883	5611	5355	5114	4885	4668	4460	4263	4074	29
30	6812	6478	6168	5878	5607	5351	5110	4881	4664	4457	4260	4071	30
31	6807	6473	6163	5874	5602	5347	5106	4877	4660	4454	4256	4068	31
32	6801	6467	6158	5869	5598	5343	5102	4874	4657	4450	4253	4065	32
33	6795	6462	6153	5864	5594	5339	5098	4870	4653	4447	4250	4062	33
34	6789	6457	6148	5860	5589	5335	5094	4866	4650	4444	4247	4059	34
35	6784	6451	6143	5855	5585	5331	5090	4863	4646	4440	4244	4055	35
36	6778	6446	6138	5850	5580	5326	5086	4859	4643	4437	4240	4052	36
37	6772	6441	6133	5846	5576	5322	5082	4855	4639	4434	4237	4049	37
38	6766	6435	6128	5841	5572	5318	5079	4852	4636	4430	4234	4046	38
39	6761	6430	6123	5836	5567	5314	5075	4848	4632	4427	4231	4043	39
40	6755	6425	6118	5832	5563	5310	5071	4844	4629	4424	4228	4040	40
41	6749	6420	6113	5827	5559	5306	5067	4841	4625	4420	4224	4037	41
42	6743	6414	6108	5823	5554	5302	5063	4837	4622	4417	4221	4034	42
43	6738	6409	6103	5818	5550	5298	5059	4833	4618	4414	4218	4031	43
44	6732	6404	6099	5813	5546	5294	5055	4830	4615	4410	4215	4028	44
45	6726	6398	6094	5809	5541	5290	5051	4826	4611	4407	4212	4025	45
46	6721	6393	6089	5804	5537	5285	5048	4822	4608	4404	4209	4022	46
47	6715	6388	6084	5800	5533	5281	5044	4819	4604	4400	4205	4019	47
48	6709	6383	6079	5795	5528	5277	5040	4815	4601	4397	4202	4016	48
49	6704	6377	6074	5790	5524	5273	5036	4811	4597	4394	4199	4013	49
50	6698	6372	6069	5786	5520	5269	5032	4808	4594	4390	4196	4010	50
51	6692	6367	6064	5781	5516	5265	5028	4804	4590	4387	4193	4007	51
52	6687	6362	6059	5777	5511	5261	5025	4800	4587	4384	4189	4004	52
53	6681	6357	6055	5772	5507	5257	5021	4797	4584	4380	4186	4001	53
54	6676	6351	6050	5768	5503	5253	5017	4793	4580	4377	4183	3998	54
55	6670	6346	6045	5763	5498	5219	5013	4789	4577	4374	4180	3995	55
56	6664	6341	6040	5758	5494	5245	5009	4786	4573	4370	4177	3991	56
57	6659	6336	6035	5754	5490	5241	5005	4782	4570	4367	4174	3988	57
58	6653	6331	6030	5749	5486	5237	5002	4778	4566	4364	4171	3985	58
59	6648	6325	6025	5745	5481	5233	4998	4775	4563	4361	4167	3982	59
60	6642	6320	6021	5740	5477	5229	4994	4771	4559	4357	4164	3979	60

TABLE XLVII.

Logarithms for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.

Sec. or ″	MINUTES OF AN HOUR OR A DEGREE.												Sec. or ″
	24	25	26	27	28	29	30	31	32	33	34	35	
0	3979	3802	3632	3468	3310	3158	3010	2868	2730	2596	2467	2341	0
1	3976	3799	3629	3465	3307	3155	3008	2866	2728	2594	2465	2339	1
2	3973	3796	3626	3463	3305	3153	3005	2863	2725	2592	2462	2337	2
3	3970	3793	3623	3460	3302	3150	3003	2861	2723	2590	2460	2335	3
4	3967	3791	3621	3457	3300	3148	3001	2859	2721	2588	2458	2333	4
5	3964	3788	3618	3454	3297	3145	2998	2856	2719	2585	2456	2331	5
6	3961	3785	3615	3452	3294	3143	2996	2854	2716	2583	2454	2328	6
7	3958	3782	3612	3449	3292	3140	2993	2852	2714	2581	2452	2326	7
8	3955	3779	3610	3446	3289	3138	2991	2849	2712	2579	2450	2324	8
9	3952	3776	3607	3444	3287	3135	2989	2847	2710	2577	2448	2322	9
10	3949	3773	3604	3441	3284	3133	2986	2845	2707	2574	2445	2320	10
11	3946	3770	3601	3438	3282	3130	2984	2842	2705	2572	2443	2318	11
12	3943	3768	3598	3436	3279	3128	2981	2840	2703	2570	2441	2316	12
13	3940	3765	3596	3433	3276	3125	2979	2838	2701	2568	2439	2314	13
14	3937	3762	3593	3431	3274	3123	2977	2835	2698	2566	2437	2312	14
15	3934	3759	3590	3428	3271	3120	2974	2833	2696	2564	2435	2310	15
16	3931	3756	3587	3425	3269	3118	2972	2831	2694	2561	2433	2308	16
17	3928	3753	3585	3423	3266	3115	2969	2828	2692	2559	2431	2306	17
18	3925	3750	3582	3420	3264	3113	2967	2826	2689	2557	2429	2304	18
19	3922	3747	3579	3417	3261	3110	2965	2824	2687	2555	2426	2302	19
20	3919	3745	3576	3415	3259	3108	2962	2821	2685	2553	2424	2300	20
21	3917	3742	3574	3412	3256	3105	2960	2819	2683	2551	2422	2298	21
22	3914	3739	3571	3409	3253	3103	2958	2817	2681	2548	2420	2296	22
23	3911	3736	3568	3407	3251	3101	2955	2815	2678	2546	2418	2294	23
24	3908	3733	3565	3404	3248	3098	2953	2812	2676	2544	2416	2291	24
25	3905	3730	3563	3401	3246	3096	2950	2810	2674	2542	2414	2289	25
26	3902	3727	3560	3399	3243	3093	2948	2808	2672	2540	2412	2287	26
27	3899	3725	3557	3396	3241	3091	2946	2805	2669	2538	2410	2285	27
28	3896	3722	3555	3393	3238	3088	2943	2803	2667	2535	2408	2283	28
29	3893	3719	3552	3391	3236	3086	2941	2801	2665	2533	2405	2281	29
30	3890	3716	3549	3388	3233	3083	2939	2798	2663	2531	2403	2279	30
31	3887	3713	3546	3386	3231	3081	2936	2796	2660	2529	2401	2277	31
32	3884	3710	3544	3383	3228	3078	2934	2794	2658	2527	2399	2275	32
33	3881	3708	3541	3380	3225	3076	2931	2792	2656	2525	2397	2273	33
34	3878	3705	3538	3378	3223	3073	2929	2789	2654	2522	2395	2271	34
35	3875	3702	3535	3375	3220	3071	2927	2787	2652	2520	2393	2269	35
36	3872	3699	3533	3372	3218	3069	2924	2785	2649	2518	2391	2267	36
37	3869	3696	3530	3370	3215	3066	2922	2782	2647	2516	2389	2265	37
38	3866	3693	3527	3367	3213	3064	2920	2780	2645	2514	2387	2263	38
39	3863	3691	3525	3365	3210	3061	2917	2778	2643	2512	2384	2261	39
40	3860	3688	3522	3362	3208	3059	2915	2775	2640	2510	2382	2259	40
41	3857	3685	3519	3359	3205	3056	2912	2773	2638	2507	2380	2257	41
42	3855	3682	3516	3357	3203	3054	2910	2771	2636	2505	2378	2255	42
43	3852	3679	3514	3354	3200	3052	2908	2769	2634	2503	2376	2253	43
44	3849	3677	3511	3351	3198	3049	2905	2766	2632	2501	2374	2251	44
45	3846	3674	3508	3349	3195	3047	2903	2764	2629	2499	2372	2249	45
46	3843	3671	3506	3346	3193	3044	2901	2762	2627	2497	2370	2247	46
47	3840	3668	3503	3344	3190	3042	2898	2760	2625	2494	2368	2245	47
48	3837	3665	3500	3341	3188	3039	2896	2757	2623	2492	2366	2243	48
49	3834	3663	3497	3338	3185	3037	2894	2755	2621	2490	2364	2241	49
50	3831	3660	3495	3336	3183	3034	2891	2753	2618	2488	2362	2239	50
51	3828	3657	3492	3333	3180	3032	2889	2750	2616	2486	2359	2237	51
52	3825	3654	3489	3331	3178	3030	2887	2748	2614	2484	2357	2235	52
53	3822	3651	3487	3328	3175	3027	2884	2746	2612	2482	2355	2233	53
54	3820	3649	3484	3325	3173	3025	2882	2744	2610	2480	2353	2231	54
55	3817	3646	3481	3323	3170	3022	2880	2741	2607	2477	2351	2229	55
56	3814	3643	3479	3320	3168	3020	2877	2739	2605	2475	2349	2227	56
57	3811	3640	3476	3318	3165	3018	2875	2737	2603	2473	2347	2225	57
58	3808	3637	3473	3315	3163	3015	2873	2735	2601	2471	2345	2223	58
59	3805	3635	3471	3313	3160	3013	2870	2732	2599	2469	2343	2220	59
60	3802	3632	3468	3310	3158	3010	2868	2730	2596	2467	2341	2218	60

TABLE XLVII.

LOGARITHMS for finding the Correction to reduce the MOON'S Declination or Right Ascension to any Time under the Meridian of Greenwich.

Sec. or ″	MINUTES OF AN HOUR OR A DEGREE.												Sec. or ″
	36	37	38	39	40	41	42	43	44	45	46	47	
0	2218	2099	1984	1871	1761	1654	1549	1447	1347	1249	1154	1061	0
1	2216	2098	1982	1869	1759	1652	1547	1445	1345	1248	1152	1059	1
2	2214	2096	1980	1867	1757	1650	1546	1443	1344	1246	1151	1057	2
3	2212	2094	1978	1865	1755	1648	1544	1442	1342	1245	1149	1056	3
4	2210	2092	1976	1863	1754	1647	1542	1440	1340	1243	1148	1054	4
5	2208	2090	1974	1862	1752	1645	1540	1438	1339	1241	1146	1053	5
6	2206	2088	1972	1860	1750	1643	1539	1437	1337	1240	1145	1051	6
7	2204	2086	1970	1858	1748	1641	1537	1435	1335	1238	1143	1050	7
8	2202	2084	1968	1856	1746	1640	1535	1433	1334	1237	1141	1048	8
9	2200	2082	1967	1854	1745	1638	1534	1432	1332	1235	1140	1047	9
10	2198	2080	1965	1852	1743	1636	1532	1430	1331	1233	1138	1045	10
11	2196	2078	1963	1850	1741	1634	1530	1428	1329	1232	1137	1044	11
12	2194	2076	1961	1849	1739	1633	1528	1427	1327	1230	1135	1042	12
13	2192	2074	1959	1847	1737	1631	1527	1425	1326	1229	1134	1041	13
14	2190	2072	1957	1845	1736	1629	1525	1423	1324	1227	1132	1039	14
15	2188	2070	1955	1843	1734	1627	1523	1422	1322	1225	1130	1037	15
16	2186	2068	1953	1841	1732	1626	1522	1420	1321	1224	1129	1036	16
17	2184	2066	1951	1839	1730	1624	1520	1418	1319	1222	1127	1034	17
18	2182	2064	1950	1838	1728	1622	1518	1417	1317	1221	1126	1033	18
19	2180	2062	1948	1836	1727	1620	1516	1415	1316	1219	1124	1031	19
20	2178	2061	1946	1834	1725	1619	1515	1413	1314	1217	1123	1030	20
21	2176	2059	1944	1832	1723	1617	1513	1412	1313	1216	1121	1028	21
22	2174	2057	1942	1830	1721	1615	1511	1410	1311	1214	1119	1027	22
23	2172	2055	1940	1828	1719	1613	1510	1408	1309	1213	1118	1025	23
24	2170	2053	1938	1827	1718	1612	1508	1407	1308	1211	1116	1024	24
25	2169	2051	1936	1825	1716	1610	1506	1405	1306	1209	1115	1022	25
26	2167	2049	1934	1823	1714	1608	1504	1403	1304	1208	1113	1021	26
27	2165	2047	1933	1821	1712	1606	1503	1402	1303	1206	1112	1019	27
28	2163	2045	1931	1819	1711	1605	1501	1400	1301	1205	1110	1018	28
29	2161	2043	1929	1817	1709	1603	1499	1398	1300	1203	1109	1016	29
30	2159	2041	1927	1816	1707	1601	1498	1397	1298	1201	1107	1015	30
31	2157	2039	1925	1814	1705	1599	1496	1395	1296	1200	1105	1013	31
32	2155	2037	1923	1812	1703	1598	1494	1393	1295	1198	1104	1012	32
33	2153	2035	1921	1810	1702	1596	1493	1392	1293	1197	1102	1010	33
34	2151	2033	1919	1808	1700	1594	1491	1390	1291	1195	1101	1008	34
35	2149	2032	1918	1806	1698	1592	1489	1388	1290	1193	1099	1007	35
36	2147	2030	1916	1805	1696	1591	1487	1387	1288	1192	1098	1005	36
37	2145	2028	1914	1803	1694	1589	1486	1385	1287	1190	1096	1004	37
38	2143	2026	1912	1801	1693	1587	1484	1383	1285	1189	1095	1002	38
39	2141	2024	1910	1799	1691	1585	1482	1382	1283	1187	1093	1001	39
40	2139	2022	1908	1797	1689	1584	1481	1380	1282	1186	1091	0999	40
41	2137	2020	1906	1795	1687	1582	1479	1378	1280	1184	1090	0998	41
42	2135	2018	1904	1794	1686	1580	1477	1377	1278	1182	1088	0996	42
43	2133	2016	1903	1792	1684	1578	1476	1375	1277	1181	1087	0995	43
44	2131	2014	1901	1790	1682	1577	1474	1373	1275	1179	1085	0993	44
45	2129	2012	1899	1788	1680	1575	1472	1372	1274	1178	1084	0992	45
46	2127	2010	1897	1786	1678	1573	1470	1370	1272	1176	1082	0990	46
47	2125	2009	1895	1785	1677	1571	1469	1368	1270	1174	1081	0989	47
48	2123	2007	1893	1783	1675	1570	1467	1367	1269	1173	1079	0987	48
49	2121	2005	1891	1781	1673	1568	1465	1365	1267	1171	1078	0986	49
50	2119	2003	1889	1779	1671	1566	1464	1363	1266	1170	1076	0984	50
51	2117	2001	1888	1777	1670	1565	1462	1362	1264	1168	1074	0983	51
52	2115	1999	1886	1775	1668	1563	1460	1360	1262	1167	1073	0981	52
53	2113	1997	1884	1774	1666	1561	1459	1359	1261	1165	1071	0980	53
54	2111	1995	1882	1772	1664	1559	1457	1357	1259	1163	1070	0978	54
55	2109	1993	1880	1770	1663	1558	1455	1355	1257	1162	1068	0977	55
56	2107	1991	1878	1768	1661	1556	1454	1354	1256	1160	1067	0975	56
57	2105	1989	1876	1766	1659	1554	1452	1352	1254	1159	1065	0974	57
58	2103	1987	1875	1765	1657	1552	1450	1350	1253	1157	1064	0972	58
59	2101	1986	1873	1763	1655	1551	1449	1349	1251	1156	1062	0971	59
60	2099	1984	1871	1761	1654	1549	1447	1347	1249	1154	1061	0969	60

TABLE XLVII

LOGARITHMS for finding the Correction to reduce the Moon's Declination or Right Ascension to any Time under the Meridian of Greenwich.

Sec. or ″	MINUTES OF AN HOUR OR A DEGREE.												Sec. or ″
	48	49	50	51	52	53	54	55	56	57	58	59	
0	0969	0880	0792	0706	0621	0539	0158	0378	0300	0223	0147	0073	0
1	0968	0878	0790	0704	0620	0537	0456	0377	0298	0221	0146	0072	1
2	0966	0877	0789	0703	0619	0536	0455	0375	0297	0220	0145	0071	2
3	0965	0875	0787	0702	0617	0535	0454	0374	0296	0219	0143	0069	3
4	0963	0874	0786	0700	0616	0533	0452	0373	0294	0218	0142	0068	4
5	0962	0872	0785	0699	0615	0532	0451	0371	0293	0216	0141	0067	5
6	0960	0871	0783	0697	0613	0531	0450	0370	0292	0215	0140	0066	6
7	0959	0869	0782	0696	0612	0529	0448	0369	0291	0214	0139	0064	7
8	0957	0868	0780	0694	0610	0528	0447	0367	0289	0213	0137	0063	8
9	0956	0866	0779	0693	0609	0526	0446	0366	0288	0211	0136	0062	9
10	0954	0865	0777	0692	0608	0525	0444	0365	0287	0210	0135	0061	10
11	0953	0863	0776	0690	0606	0524	0443	0363	0285	0209	0134	0060	11
12	0951	0862	0774	0689	0605	0522	0442	0362	0284	0208	0132	0058	12
13	0950	0860	0773	0687	0603	0521	0440	0361	0283	0206	0131	0057	13
14	0948	0859	0772	0686	0602	0520	0439	0359	0282	0205	0130	0056	14
15	0947	0857	0770	0685	0601	0518	0438	0358	0280	0204	0129	0055	15
16	0945	0856	0769	0683	0599	0517	0436	0357	0279	0202	0127	0053	16
17	0944	0855	0767	0682	0598	0516	0435	0356	0278	0201	0126	0052	17
18	0942	0853	0766	0680	0596	0514	0434	0354	0276	0200	0125	0051	18
19	0941	0852	0764	0679	0595	0513	0432	0353	0275	0199	0124	0050	19
20	0939	0850	0763	0678	0594	0512	0431	0352	0274	0197	0122	0049	20
21	0938	0849	0762	0676	0592	0510	0430	0350	0273	0196	0121	0047	21
22	0936	0847	0760	0675	0591	0509	0428	0349	0271	0195	0120	0046	22
23	0935	0846	0759	0673	0590	0507	0427	0348	0270	0194	0119	0045	23
24	0933	0844	0757	0672	0588	0506	0426	0346	0269	0192	0117	0044	24
25	0932	0843	0756	0670	0587	0505	0424	0345	0267	0191	0116	0042	25
26	0930	0841	0754	0669	0585	0503	0423	0344	0266	0190	0115	0041	26
27	0929	0840	0753	0668	0584	0502	0422	0342	0265	0189	0114	0040	27
28	0927	0838	0751	0666	0583	0501	0420	0341	0264	0187	0112	0039	28
29	0926	0837	0750	0665	0581	0499	0419	0340	0262	0186	0111	0038	29
30	0924	0835	0749	0663	0580	0498	0418	0339	0261	0185	0110	0036	30
31	0923	0834	0747	0662	0579	0497	0416	0337	0260	0184	0109	0035	31
32	0921	0833	0746	0661	0577	0495	0415	0336	0258	0182	0107	0034	32
33	0920	0831	0744	0659	0576	0494	0414	0335	0257	0181	0106	0033	33
34	0918	0830	0743	0658	0574	0493	0412	0333	0256	0180	0105	0031	34
35	0917	0828	0741	0656	0573	0491	0411	0332	0255	0179	0104	0030	35
36	0915	0827	0740	0655	0572	0490	0410	0331	0253	0177	0103	0029	36
37	0914	0825	0739	0654	0570	0489	0408	0329	0252	0176	0101	0028	37
38	0912	0824	0737	0652	0569	0487	0407	0328	0251	0175	0100	0027	38
39	0911	0822	0736	0651	0568	0486	0406	0327	0250	0174	0099	0025	39
40	0909	0821	0734	0649	0566	0484	0404	0326	0248	0172	0098	0024	40
41	0908	0819	0733	0648	0565	0483	0403	0324	0247	0171	0096	0023	41
42	0906	0818	073	0647	0563	0482	0402	0323	0246	0170	0095	0022	42
43	0905	0816	0730	0645	0562	0480	0400	0322	0244	0169	0094	0021	43
44	0903	0815	0729	0644	0561	0479	0399	0320	0243	0167	0093	0019	44
45	0902	0814	0727	0642	0559	0478	0398	0319	0242	0166	0091	0018	45
46	0900	0812	0726	0641	0558	0476	0396	0318	0241	0165	0090	0017	46
47	0899	0811	0724	0640	0557	0475	0395	0316	0239	0163	0089	0016	47
48	0897	0809	0723	0638	0555	0474	0394	0315	0238	0162	0088	0015	48
49	0896	0808	0721	0637	0554	0472	0392	0314	0237	0161	0087	0013	49
50	0894	0806	0720	0635	0552	0471	0391	0313	0235	0160	0085	0012	50
51	0893	0805	0719	0634	0551	0470	0390	0311	0234	0158	0084	0011	51
52	0891	0803	0717	0633	0550	0468	0388	0310	0233	0157	0083	0010	52
53	0890	0802	0716	0631	0548	0467	0387	0309	0232	0156	0082	0008	53
54	0888	0801	0714	0630	0547	0466	0386	0307	0230	0155	0080	0007	54
55	0887	0799	0713	0628	0546	0464	0384	0306	0229	0153	0079	0006	55
56	0885	0798	0711	0627	0544	0463	0383	0305	0228	0152	0078	0005	56
57	0884	0796	0710	0626	0543	0462	0382	0304	0227	0151	0077	0004	57
58	0883	0795	0709	0624	0541	0460	0381	0302	0225	0150	0075	0002	58
59	0881	0793	0707	0623	0540	0459	0379	0301	0224	0148	0074	0001	59
60	0880	0792	0706	0621	0539	0458	0378	0300	0223	0147	0073	0000	60

TABLE XLVIII.

The Parallax in Altitude for Planets.

Planet's App. Alt.	Planet's Horizontal Parallax.																	Planet's App. Alt.
	1″	3″	5″	7″	9″	11″	13″	15″	17″	19″	21″	23″	25″	27″	29″	31″	33″	
3°	1″	3″	5″	7″	9″	11″	13″	15″	17″	19″	21″	23″	25″	27″	29″	31″	33″	3°
4	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	4
5	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	5
6	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	6
7	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	7
8	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	8
9	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	9
10	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	32	10
11	1	3	5	7	9	11	13	15	17	19	21	23	25	26	28	30	32	11
12	1	3	5	7	9	11	13	15	17	19	21	22	24	26	28	30	32	12
14	1	3	5	7	9	11	13	15	16	18	20	22	24	26	28	30	32	14
16	1	3	5	7	9	11	12	14	16	18	20	22	24	26	28	30	32	16
18	1	3	5	7	9	10	12	14	16	18	20	22	24	26	28	29	31	18
20	1	3	5	7	8	10	12	14	16	18	20	22	24	25	27	29	31	20
23	1	3	5	6	8	10	12	14	16	17	19	21	23	25	27	29	30	23
26	1	3	4	6	8	10	12	13	15	17	19	21	22	24	26	28	30	26
29	1	3	4	6	8	10	11	13	15	17	18	20	22	24	25	27	29	29
32	1	2	4	6	8	9	11	13	14	16	18	19	21	23	25	26	28	32
35	1	2	4	6	7	9	11	12	14	16	17	19	20	22	24	25	27	35
40	1	2	4	5	7	8	10	12	13	15	16	18	19	21	22	24	25	40
45	1	2	3	5	6	8	9	11	12	13	15	16	18	19	21	22	23	45
50	1	2	3	5	6	7	8	10	11	12	13	15	16	17	19	20	21	50
55	1	2	3	4	5	6	7	9	10	11	12	13	14	15	17	18	19	55
60	0	2	3	4	5	5	6	7	8	9	10	11	12	13	14	15	16	60
65	0	1	2	3	4	5	5	6	7	8	9	10	11	11	12	13	14	65
70	0	1	2	2	3	4	4	5	6	6	7	8	9	9	10	11	11	70
75	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	75
80	0	0	1	1	2	2	2	3	3	3	4	4	4	5	5	5	6	80
85	0	0	0	1	1	1	1	1	1	2	2	2	2	2	2	3	3	85
90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	90

TABLE XLIX

To correct the Logarithmic Difference when a Planet is observed.

Planet's App. Alt.	Planet's Horizontal Parallax.																	Planet's App. Alt.
	1″	3″	5″	7″	9″	11″	13″	15″	17″	19″	21″	23″	25″	27″	29″	31″	33″	
3°	27	28	28	28	28	28	29	29	29	29	29	30	30	30	30	30	31	3°
4	18	18	19	19	19	19	20	20	20	21	21	21	21	22	22	22	23	4
5	12	13	13	14	14	14	15	15	15	16	16	17	17	17	17	18	18	5
6	9	10	10	10	11	11	12	12	13	13	13	14	14	15	15	16	16	6
7	8	8	8	9	10	10	11	11	12	12	13	13	14	14	15	15	15	7
8	6	7	7	8	8	9	10	10	11	11	12	12	13	14	14	15	15	8
9	5	6	6	7	7	8	9	9	10	11	11	12	13	14	14	15	15	9
10	4	5	5	6	7	8	8	9	10	11	11	12	13	14	14	15	15	10
11	3	4	5	6	7	8	8	9	10	11	11	12	13	14	15	15	16	11
12	3	4	5	6	7	8	8	9	10	11	12	13	14	15	16	16	17	12
14	3	4	5	6	7	8	9	9	10	11	13	14	15	16	17	17	18	14
16	2	3	4	5	7	8	9	10	11	12	14	15	16	17	18	19	20	16
18	2	3	4	6	7	8	9	11	12	13	15	16	18	19	20	21	22	18
20	2	3	4	6	8	9	10	12	13	14	16	18	20	21	22	23	25	20
23	2	3	4	7	8	10	11	13	14	16	18	20	22	23	25	26	28	23
26	2	3	4	7	9	11	13	14	16	17	20	21	24	25	28	29	31	26
29	2	3	4	7	9	12	14	15	17	19	22	23	26	27	31	32	34	29
32	2	3	5	8	10	13	15	17	19	21	24	25	28	30	34	35	37	32
35	2	3	6	9	11	14	17	19	21	23	26	28	31	33	37	38	42	35
40	2	3	7	9	12	15	18	21	23	26	28	31	34	37	40	42	46	40
45	2	4	7	10	13	17	19	23	25	28	31	34	37	40	43	46	50	45
50	2	5	8	11	14	18	21	24	27	31	34	37	40	43	46	50	54	50
55	2	6	9	12	15	19	22	26	29	33	36	40	43	46	49	54	57	55
60	2	6	9	13	16	20	23	27	31	35	38	42	46	49	52	57	60	60
65	2	6	10	13	17	21	24	29	32	36	40	44	48	51	55	59	63	65
70	2	6	10	14	18	22	25	30	33	38	42	46	49	53	57	61	65	70
75	2	6	10	14	18	22	26	30	34	39	43	47	50	55	59	63	67	75
80	2	6	10	14	19	23	27	31	35	39	44	48	51	56	60	64	68	80
85	2	6	10	15	19	23	27	31	36	40	44	48	52	57	61	65	69	85
90	2	6	10	15	19	23	27	31	36	40	44	48	52	57	61	65	69	90

TABLE L.

To correct the Auxiliary Angle when a Planet is observed.—Additive.

Planet's App. Alt.	Planet's Horizontal Parallax.																	Planet's App. Alt
	1″	3″	5″	7″	9″	11″	13″	15″	17″	19″	21″	23″	25″	27″	29″	31″	33″	
3°	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	8″	3°
4	5	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	4
5	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5	5	5	5
6	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	6
7	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	4	7
8	2	2	2	2	2	2	3	3	3	3	3	3	4	4	4	4	4	8
9	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4	9
10	1	1	1	2	2	2	2	2	3	3	3	3	4	4	4	4	4	10
11	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	4	11
12	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4	4	5	12
14	1	1	1	1	2	2	2	2	3	3	3	4	4	4	4	5	5	14
16	1	1	1	1	2	2	2	3	3	4	4	4	4	5	5	5	6	16
18	1	1	1	1	2	2	2	3	3	4	4	4	5	5	5	5	6	18
20	1	1	1	1	2	2	3	3	4	4	5	5	6	6	6	6	7	20
23	1	1	1	2	2	3	3	4	4	4	5	5	6	7	7	7	8	23
26	1	1	1	2	3	3	3	4	4	5	6	6	7	7	8	8	8	26
29	1	1	1	2	3	3	4	5	5	5	6	6	7	7	8	8	9	29
32	1	1	1	2	3	3	4	5	5	6	7	7	8	8	9	10	10	32
35	1	1	2	2	3	3	5	6	6	6	7	7	8	8	9	10	11	35
40	1	1	2	2	3	3	5	6	6	7	8	8	9	10	11	11	12	40
45	1	1	2	3	3	4	5	6	7	8	9	9	10	11	12	13	14	45
50	1	1	3	3	4	4	6	7	8	9	9	10	11	12	13	14	15	50
55	1	1	3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	55
60	1	1	3	4	4	5	6	7	8	9	10	12	13	14	14	16	17	60
65	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	65
70	1	2	3	4	5	6	7	8	9	10	11	12	13	15	16	17	18	70
75	1	2	3	4	5	6	7	8	9	10	12	13	14	15	16	17	18	75
80	1	2	3	4	5	6	7	8	10	11	12	13	14	15	16	18	19	80
85	1	2	3	4	5	6	7	8	10	11	12	13	14	16	17	18	19	85
90	1	2	3	4	5	6	7	8	10	11	12	13	14	16	17	18	19	90

TABLE LI.

To reduce the Equation of Time to any Time under the Meridian of Greenwich.

Greenw. Time.	DAILY VARIATION.															
	1s	2s	4s	6s	8s	10s	12s	14s	16s	18s	20s	22s	24s	26s	28s	30s
h. m.	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
0 30	0.0	0.0	0.1	0.1	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6
1 0	0.0	0.1	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.2
1 30	0.1	0.1	0.2	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.3	1.4	1.5	1.6	1.7	1.8
2 0	0.1	0.2	0.3	0.5	0.7	0.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5
2 30	0.1	0.2	0.4	0.6	0.8	1.0	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1
3 0	0.1	0.3	0.5	0.7	1.0	1.2	1.5	1.8	2.0	2.2	2.5	2.7	3.0	3.2	3.5	3.7
3 30	0.1	0.3	0.6	0.9	1.2	1.5	1.8	2.0	2.3	2.6	2.9	3.2	3.5	3.7	4.1	4.4
4 0	0.2	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.6	3.0	3.3	3.7	4.0	4.3	4.7	5.0
4 30	0.2	0.4	0.7	1.1	1.5	1.9	2.3	2.6	3.0	3.4	3.7	4.1	4.5	4.9	5.2	5.6
5 0	0.2	0.4	0.8	1.2	1.7	2.1	2.5	2.9	3.3	3.8	4.2	4.6	5.0	5.4	5.8	6.2
5 30	0.2	0.5	0.9	1.4	1.8	2.3	2.8	3.2	3.7	4.1	4.6	5.0	5.5	5.9	6.4	6.8
6 0	0.2	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0	6.5	7.0	7.5
6 30	0.3	0.5	1.1	1.6	2.2	2.7	3.3	3.8	4.3	4.9	5.4	5.9	6.5	7.0	7.6	8.1
7 0	0.3	0.6	1.2	1.7	2.3	2.9	3.5	4.1	4.7	5.2	5.8	6.4	7.0	7.5	8.1	8.7
7 30	0.3	0.6	1.2	1.9	2.5	3.1	3.8	4.4	5.0	5.6	6.3	6.9	7.5	8.1	8.7	9.4
8 0	0.3	0.7	1.3	2.0	2.7	3.3	4.0	4.7	5.3	6.0	6.7	7.3	8.0	8.6	9.3	10.0
8 30	0.4	0.7	1.4	2.1	2.8	3.5	4.3	5.0	5.7	6.4	7.1	7.8	8.5	9.2	9.9	10.6
9 0	0.4	0.7	1.5	2.2	3.0	3.7	4.5	5.2	6.0	6.8	7.5	8.2	9.0	9.7	10.4	11.2
9 30	0.4	0.8	1.6	2.4	3.2	4.0	4.8	5.5	6.3	7.1	7.9	8.7	9.5	10.2	11.0	11.8
10 0	0.4	0.8	1.7	2.5	3.3	4.2	5.0	5.8	6.7	7.5	8.3	9.2	10.0	10.8	11.6	12.5
10 30	0.4	0.9	1.7	2.6	3.5	4.4	5.3	6.1	7.0	7.9	8.7	9.6	10.5	11.4	12.2	13.1
11 0	0.5	0.9	1.8	2.7	3.7	4.6	5.5	6.4	7.3	8.2	9.2	10.0	11.0	11.9	12.8	13.7
11 30	0.5	1.0	1.9	2.9	3.8	4.8	5.8	6.7	7.7	8.6	9.6	10.5	11.5	12.4	13.4	14.4
12 0	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0

TABLE LII.

LOGARITHMS for computing the EQUATION of EQUAL ALTITUDES.

Interval.	Log. A.	Log. B.	Interval.	Log. A.	Log. B.	Interval.	Log. A.	Log. B.	Interval.	Log. A.	Log. B
h. m.			h. m.			h. m.			h. m.		
2 0	7.7297	7.7146	4 0	7.7447	7.6823	6 0	7.7703	7.6198	8 0	7.8072	7.5062
2	7.7298	7.7143	2	7.7451	7.6815	2	7.7708	7.6184	2	7.8079	7.5036
4	7.7300	7.7139	4	7.7454	7.6807	4	7.7713	7.6170	4	7.8086	7.5010
6	7.7302	7.7136	6	7.7458	7.6800	6	7.7719	7.6156	6	7.8094	7.4983
8	7.7304	7.7132	8	7.7461	7.6792	8	7.7724	7.6142	8	7.8101	7.4957
10	7.7305	7.7128	10	7.7464	7.6784	10	7.7729	7.6127	10	7.8108	7.4930
12	7.7307	7.7125	12	7.7468	7.6776	12	7.7735	7.6113	12	7.8116	7.4902
14	7.7309	7.7121	14	7.7472	7.6768	14	7.7740	7.6098	14	7.8123	7.4874
16	7.7311	7.7117	16	7.7475	7.6759	16	7.7745	7.6083	16	7.8130	7.4846
18	7.7313	7.7113	18	7.7479	7.6751	18	7.7751	7.6068	18	7.8138	7.4818
2 20	7.7315	7.7109	4 20	7.7482	7.6743	6 20	7.7756	7.6053	8 20	7.8145	7.4789
22	7.7317	7.7105	22	7.7486	7.6734	22	7.7762	7.6038	22	7.8153	7.4760
24	7.7319	7.7101	24	7.7490	7.6726	24	7.7767	7.6023	24	7.8160	7.4731
26	7.7321	7.7097	26	7.7494	7.6717	26	7.7773	7.6007	26	7.8168	7.4701
28	7.7323	7.7092	28	7.7497	7.6708	28	7.7779	7.5991	28	7.8176	7.4671
30	7.7325	7.7088	30	7.7501	7.6700	30	7.7784	7.5975	30	7.8183	7.4640
32	7.7327	7.7083	32	7.7505	7.6691	32	7.7790	7.5959	32	7.8191	7.4609
34	7.7329	7.7079	34	7.7509	7.6682	34	7.7796	7.5943	34	7.8199	7.4578
36	7.7331	7.7075	36	7.7513	7.6673	36	7.7801	7.5927	36	7.8206	7.4546
38	7.7333	7.7070	38	7.7517	7.6663	38	7.7807	7.5910	38	7.8214	7.4514
2 40	7.7336	7.7065	4 40	7.7521	7.6654	6 40	7.7813	7.5894	8 40	7.8222	7.4482
42	7.7338	7.7061	42	7.7525	7.6645	42	7.7819	7.5877	42	7.8230	7.4449
44	7.7340	7.7056	44	7.7529	7.6635	44	7.7825	7.5860	44	7.8238	7.4415
46	7.7342	7.7051	46	7.7533	7.6626	46	7.7831	7.5843	46	7.8246	7.4381
48	7.7345	7.7046	48	7.7537	7.6616	48	7.7836	7.5825	48	7.8254	7.4347
50	7.7347	7.7041	50	7.7541	7.6606	50	7.7842	7.5808	50	7.8262	7.4312
52	7.7349	7.7036	52	7.7545	7.6597	52	7.7848	7.5790	52	7.8270	7.4277
54	7.7352	7.7031	54	7.7549	7.6587	54	7.7854	7.5772	54	7.8278	7.4241
56	7.7354	7.7026	56	7.7553	7.6577	56	7.7860	7.5754	56	7.8286	7.4205
58	7.7357	7.7021	58	7.7557	7.6567	58	7.7867	7.5736	58	7.8294	7.4168
3 0	7.7359	7.7015	5 0	7.7562	7.6556	7 0	7.7873	7.5717	9 0	7.8302	7.4131
2	7.7362	7.7010	2	7.7566	7.6546	2	7.7879	7.5699	2	7.8311	7.4093
4	7.7364	7.7005	4	7.7570	7.6536	4	7.7885	7.5680	4	7.8319	7.4055
6	7.7367	7.6999	6	7.7575	7.6525	6	7.7891	7.5661	6	7.8328	7.4016
8	7.7369	7.6993	8	7.7579	7.6514	8	7.7898	7.5641	8	7.8336	7.3977
10	7.7372	7.6988	10	7.7583	7.6504	10	7.7904	7.5622	10	7.8344	7.3937
12	7.7374	7.6982	12	7.7588	7.6193	12	7.7910	7.5602	12	7.8353	7.3896
14	7.7377	7.6976	14	7.7592	7.6482	14	7.7916	7.5582	14	7.8361	7.3855
16	7.7380	7.6970	16	7.7597	7.6471	16	7.7923	7.5562	16	7.8370	7.3813
18	7.7383	7.6964	18	7.7601	7.6460	18	7.7929	7.5542	18	7.8378	7.3771
3 20	7.7386	7.6958	5 20	7.7606	7.6448	7 20	7.7936	7.5522	9 20	7.8387	7.3728
22	7.7388	7.6952	22	7.7610	7.6437	22	7.7912	7.5501	22	7.8396	7.3684
24	7.7391	7.6946	24	7.7615	7.6425	24	7.7949	7.5480	24	7.8404	7.3639
26	7.7394	7.6940	26	7.7620	7.6414	26	7.7955	7.5459	26	7.8413	7.3594
28	7.7397	7.6934	28	7.7624	7.6402	28	7.7962	7.5437	28	7.8422	7.3548
30	7.7400	7.6927	30	7.7629	7.6390	30	7.7969	7.5416	30	7.8430	7.3501
32	7.7403	7.6921	32	7.7634	7.6378	32	7.7975	7.5394	32	7.8439	7.3454
34	7.7406	7.6914	34	7.7638	7.6366	34	7.7982	7.5372	34	7.8448	7.3406
36	7.7409	7.6908	36	7.7643	7.6354	36	7.7989	7.5350	36	7.8457	7.3357
38	7.7412	7.6901	38	7.7648	7.6342	38	7.7995	7.5327	38	7.8466	7.3307
3 40	7.7415	7.6894	5 40	7.7653	7.6329	7 40	7.8002	7.5304	9 40	7.8475	7.3256
42	7.7418	7.6888	42	7.7658	7.6317	42	7.8009	7.5281	42	7.8484	7.3205
44	7.7421	7.6881	44	7.7663	7.6304	44	7.8016	7.5258	44	7.8493	7.3152
46	7.7424	7.6874	46	7.7668	7.6291	46	7.8023	7.5234	46	7.8502	7.3099
48	7.7428	7.6867	48	7.7673	7.6278	48	7.8030	7.5211	48	7.8511	7.3045
50	7.7431	7.6859	50	7.7678	7.6265	50	7.8037	7.5186	50	7.8520	7.2989
52	7.7434	7.6852	52	7.7683	7.6252	52	7.8044	7.5162	52	7.8530	7.2933
54	7.7437	7.6845	54	7.7688	7.6239	54	7.8051	7.5137	54	7.8539	7.2876
56	7.7441	7.6838	56	7.7693	7.6225	56	7.8058	7.5112	56	7.8548	7.2817
58	7.7444	7.6830	58	7.7698	7.6212	58	7.8065	7.5087	58	7.8558	7.2758
4 0	7.7447	7.6823	6 0	7.7703	7.6198	8 0	7.8072	7.5062	10 0	7.8567	7.2697

TABLE LIII.

For converting Foreign Measures into English feet or fathoms, and the contrary.

English feet.	French feet.		Spanish feet.	Portuguese feet.		Amsterdam feet.	Rynland feet.	Swedish feet.	Venetian feet.		Russian feet.
English fathoms	French toises.	French brasses.	Spanish brazas.		Portuguese braças.			Swedish fathoms		Venetian passi.	
1	0.94	1.13	1.08	0.93	0.83	1.08	0.97	1.03	0.88	1.05	0.87
2	1.88	2.25	2.16	1.85	1.67	2.15	1.94	2.05	1.75	2.11	1.75
3	2.82	3.38	3.24	2.78	2.50	3.23	2.92	3.08	2.63	3.16	2.62
4	3.76	4.50	4.32	3.71	3.33	4.31	3.89	4.11	3.51	4.21	3.49
5	4.70	5.63	5.40	4.63	4.17	5.39	4.86	5.14	4.39	5.26	4.36
6	5.63	6.76	6.48	5.56	5.00	6.46	5.83	6.16	5.26	6.32	5.24
7	6.57	7.88	7.55	6.49	5.83	7.54	6.80	7.19	6.14	7.37	6.11
8	7.51	9.01	8.63	7.41	6.67	8.61	7.77	8.22	7.02	8.42	6.98
9	8.45	10.13	9.71	8.34	7.50	9.70	8.75	9.25	7.90	9.47	7.85
10	9.39	11.26	10.79	9.27	8.33	10.77	9.71	10.27	8.77	10.52	8.73
11	10.33	12.39	11.87	10.20	9.17	11.85	10.69	11.30	9.65	11.58	9.60
12	11.27	13.51	12.95	11.12	10.00	12.93	11.66	12.33	10.53	12.63	10.47
13	12.21	14.64	14.03	12.05	10.83	14.00	12.63	13.36	11.40	13.68	11.35
14	13.15	15.76	15.11	12.97	11.67	15.08	13.60	14.38	12.28	14.74	12.22
15	14.09	16.89	16.19	13.90	12.50	16.16	14.58	15.41	13.16	15.79	13.09
16	15.02	18.02	17.27	14.83	13.33	17.24	15.55	16.44	14.04	16.84	13.96
17	15.96	19.14	18.35	15.75	14.17	18.31	16.52	17.46	14.91	17.89	14.83
18	16.90	20.27	19.43	16.68	15.00	19.39	17.49	18.49	15.79	18.95	15.70
19	17.84	21.39	20.51	17.61	15.84	20.47	18.46	19.52	16.67	20.00	16.58
20	18.78	22.52	21.58	18.54	16.67	21.54	19.43	20.55	17.54	21.05	17.45
21	19.72	23.64	22.66	19.46	17.50	22.62	20.40	21.57	18.42	22.11	18.33
22	20.66	24.77	23.74	20.39	18.33	23.69	21.37	22.59	19.30	23.16	19.20
23	21.60	25.90	24.82	21.31	19.17	24.77	22.34	23.62	20.18	24.21	20.07
24	22.54	27.02	25.90	22.24	20.00	25.85	23.31	24.65	21.05	25.26	20.94
25	23.47	28.15	26.98	23.17	20.83	26.93	24.29	25.68	21.93	26.32	21.82
26	24.41	29.27	28.05	24.09	21.67	28.00	25.26	26.70	22.81	27.37	22.69
27	25.35	30.40	29.13	25.02	22.50	29.08	26.23	27.73	23.69	28.42	23.56
28	26.29	31.53	30.21	25.95	23.33	30.16	27.20	28.76	24.57	29.47	24.44
29	27.23	32.66	31.29	26.87	24.17	31.23	28.17	29.78	25.44	30.52	25.31
30	28.17	33.78	32.37	27.80	25.00	32.31	29.14	30.81	26.32	31.58	26.18
31	29.11	34.90	33.45	28.73	25.83	33.39	30.11	31.84	27.19	32.63	27.05
32	30.05	36.03	34.53	29.65	26.67	34.47	31.08	32.86	28.07	33.68	27.93
33	30.99	37.15	35.61	30.58	27.50	35.54	32.06	33.89	28.95	34.74	28.80
34	31.93	38.28	36.69	31.51	28.33	36.62	33.03	34.92	29.82	35.79	29.67
35	32.87	39.40	37.77	32.43	29.17	37.69	34.00	35.95	30.70	36.84	30.54
36	33.80	40.53	38.84	33.36	30.00	38.77	34.97	36.97	31.58	37.89	31.42
37	34.74	41.65	39.92	34.29	30.84	39.85	35.94	38.00	32.46	38.95	32.29
38	35.68	42.78	41.00	35.21	31.67	40.93	36.92	39.03	33.33	40.00	33.16
39	36.62	43.90	42.08	36.14	32.50	42.00	37.89	40.05	34.21	41.05	34.04
40	37.56	45.03	43.16	37.07	33.33	43.08	38.86	41.08	35.09	42.11	34.91
41	38.50	46.16	44.24	37.99	34.17	44.16	39.83	42.11	35.97	43.16	35.78
42	39.44	47.29	45.32	38.92	35.00	45.24	40.80	43.14	36.84	44.21	36.65
43	40.38	48.42	46.40	39.84	35.83	46.31	41.77	44.16	37.72	45.26	37.53
44	41.32	49.54	47.48	40.77	36.67	47.39	42.75	45.19	38.60	46.32	38.40
45	42.26	50.67	48.55	41.70	37.50	48.47	43.71	46.22	39.47	47.37	39.27
46	43.19	51.79	49.63	42.63	38.33	49.54	44.69	47.25	40.35	48.42	40.11
47	44.12	52.92	50.71	43.55	39.17	50.62	45.66	48.27	41.23	49.47	41.02
48	45.07	54.05	51.79	44.48	40.00	51.69	46.63	49.30	42.11	50.52	41.89
49	46.01	55.17	52.87	45.41	40.83	52.77	47.60	50.33	42.98	51.58	42.76
50	46.95	56.30	53.95	46.34	41.67	53.85	48.58	51.36	43.86	52.63	43.64
51	47.89	57.43	55.03	47.26	42.50	54.93	49.55	52.38	44.74	53.68	44.51
52	48.83	58.55	56.11	48.19	43.33	56.00	50.52	53.41	45.61	54.74	45.38
53	49.77	59.68	57.19	49.12	44.17	57.08	51.49	54.44	46.49	55.79	46.25
54	50.71	60.81	58.27	50.04	45.00	58.16	52.46	55.46	47.37	56.84	47.13
55	51.65	61.93	59.35	50.97	45.83	59.24	53.43	56.49	48.25	57.89	48.00
56	52.58	63.06	60.43	51.90	46.67	60.31	54.40	57.52	49.12	58.95	48.87
57	53.52	64.19	61.51	52.82	47.50	61.39	55.37	58.55	50.00	60.00	49.75
58	54.46	65.31	62.58	53.75	48.33	62.47	56.34	59.57	50.88	61.05	50.62
59	55.40	66.44	63.66	54.68	49.17	63.54	57.31	60.59	51.75	62.11	51.49
60	56.34	67.57	64.74	55.60	50.00	64.62	58.29	61.62	52.63	63.16	52.36

TABLE LIII.

For converting Foreign Measures into English feet or fathoms, and the contrary.

English feet.	French feet.		Spanish feet.	Portuguese feet.		Amsterdam feet.	Rynland feet.	Swedish feet.	Venetian feet.		Russian feet.
English fathoms	French toises.	French brasses.	Spanish brazas.		Portuguese braças.			Swedish fathoms		Venetian passi.	
61	57.28	68.68	65.82	56.54	50.83	65.69	59.26	62.65	53.51	64.21	53.24
62	58.22	69.81	66.90	57.46	51.67	66.77	60.23	63.68	54.39	65.26	54.11
63	59.16	70.94	67.98	58.39	52.50	67.85	61.20	64.70	55.26	66.32	54.98
64	60.10	72.06	69.05	59.31	53.33	68.93	62.17	65.73	56.14	67.37	55.85
65	61.04	73.19	70.13	60.24	54.17	70.00	63.14	66.76	57.02	68.42	56.73
66	61.97	74.31	71.21	61.17	55.00	71.08	64.11	67.78	57.90	69.47	57.60
67	62.91	75.14	72.29	62.09	55.83	72.16	65.08	68.81	58.77	70 52	58.47
68	63.85	76.57	73.37	63.02	56.67	73.24	66.06	69.84	59.65	71.58	59.35
69	64.79	77.69	74.45	63.95	57.50	74.31	67.03	70.86	60.53	72.63	60 22
70	65.73	78.82	75.53	64.87	58.33	75.39	68.00	71.89	61.40	73.68	61.09
71	66.67	79.95	76.61	65.80	59.17	76.47	68.97	72.92	62.28	74.74	61 96
72	67.61	81.08	77.69	66.73	60.00	77.54	69.94	73.95	63.16	75.79	62.83
73	68.55	82.21	78.77	67.65	60.83	78.62	70.92	74.97	64.04	76.84	63.70
74	69.49	83.33	79.84	68.58	61.67	79.69	71.89	76.00	64.91	77.89	64.58
75	70.43	84.46	80.92	69.51	62.50	80.77	72.86	77.03	65.79	78.95	65.45
76	71.36	85.59	82.00	70.43	63.33	81.85	73.83	78.05	66.67	80.00	66.33
77	72.30	86.71	83.08	71.36	64.17	82.93	74.80	79.08	67.54	81.05	67.20
78	73.24	87.84	84.16	72.29	65.00	84.00	75.77	80.11	68.42	82.11	68.07
79	74.18	88.97	85.24	73 21	65.83	85.08	76.75	81.14	69.30	83.16	68.94
80	75.12	90.10	86.32	74.14	66.67	86.16	77.71	82.16	70.18	84.21	69.82
81	76.06	91.22	87.40	75.07	67.50	87.24	78.69	83.19	71.05	85.26	70.69
82	77.00	92.35	88.48	75.99	68.33	88.31	79.66	84.22	71.93	86.32	71.56
83	77.94	93.47	89.55	76.93	69.17	89.39	80.63	85.25	72.81	87.37	72.44
84	78.88	94.60	90.63	77.85	70.00	90.47	81 60	86.27	73.69	88.42	73.31
85	79 82	95.73	91.71	78.78	70.83	91.54	82.58	87.30	74.57	89 47	74.18
86	80.76	96.86	92 79	79.71	71.67	92.62	83.55	88.33	75.44	90.52	75.05
87	81.70	97.98	93.87	80.63	72.50	93.69	84.52	89.36	76.32	91.58	75.93
88	82.63	99.10	94.95	81.56	73.33	94.77	85.49	90.38	77.19	92.63	76.80
89	83.57	100.23	96.03	82.49	74.17	95.85	86.46	91.41	78.07	93.68	77.67
90	84.51	101.35	97.11	83.41	75.00	96.93	87.43	92.44	78.95	94.74	78 54
91	85.45	102.46	98.19	84.34	75.83	98.00	88.40	93.46	79.82	95.79	79.42
92	86.39	103.59	99.27	85.27	76.67	99.08	89.37	94.49	80.70	96.84	80 29
93	87.33	104.72	100.35	86.20	77.50	100.16	90.34	95.52	81.58	97.89	81.16
94	88.27	105.84	101.43	87.12	78.33	101.24	91.31	96.55	82.46	98.95	82.04
95	89.21	106.97	102.51	88.05	79.17	102.31	92.29	97.57	83.33	100.00	82 91
96	90.15	108.09	103.58	88.97	80.00	103.39	93.26	98.59	84.21	101.05	83.78
97	91.09	109.22	104.66	89.90	80.83	101.47	94.23	99.62	85.09	102.11	84.65
98	92.02	110 35	105.74	90.83	81.67	105.54	95.20	100.65	85.97	103.16	85.53
99	92.96	111.47	106.82	91.75	82.50	106.62	96.17	101.68	86.84	104.21	86.40
100	93 90	112.59	107.90	92.68	83.33	107.69	97.14	102.70	87.72	105.26	87.27
101	94.84	113.72	108.98	93.61	84.17	108.77	98.11	103.73	88.60	106.32	88.14
102	95.78	114.85	110.05	94.54	85.00	109.85	99.08	104.76	89.47	107.37	89.02
103	96.72	115 97	111.13	95.46	85.83	110.93	100.06	105.78	90.35	108.42	89.89
104	97.66	117.10	112.21	96.39	86.67	112.00	101.03	106.81	91.23	109.47	90 76
105	98.60	118.23	113.29	97.31	87.50	113.08	102.00	107.84	92.11	110.52	91.64
106	99.54	119.35	114.37	98.24	88.33	114.16	102.97	108.86	92.98	111.58	92.51
107	100.47	120.48	115.45	99.17	89.17	115.24	103.94	109.89	93.86	112.63	93 38
108	101.41	121 60	116.53	100.09	90.00	116.31	104.92	110.92	94.74	113 68	94 25
109	102.35	122.72	117.61	101.02	90.83	117.39	105.89	111.95	95.61	114.74	95 13
110	103.29	123.85	118.69	101.95	91.67	118.47	106.86	112.97	96.49	115.79	96 00
111	104.23	124.98	119.77	102.87	92.50	119.54	107.83	114.00	97.37	116.84	96.87
112	105.17	126 11	120.84	103.80	93.33	120.62	108.80	115.03	98.25	117.89	97 75
113	106.11	127.23	121.92	104.73	94.17	121.69	109.77	116.05	99.12	118.95	98 62
114	107.05	128.36	123.00	105.65	95.00	122.77	110.75	117.08	100.00	120.00	99.49
115	107.99	129.48	124.08	106.58	95.83	123.85	111.71	118.11	100.88	121.05	100 36
116	108.93	130.61	125.16	107.51	96.67	124.93	112.69	119.14	101.75	122.11	101.24
117	109.87	131.74	126.24	108.43	97.50	126.00	113 66	120.16	102 63	123.16	102.11
118	110.80	132.87	127.32	109.36	98.33	127.08	114.63	121.19	103.51	124.21	102.98
119	111.74	134.00	128.40	110.29	99.17	128.16	115.60	122.22	104.39	125.26	103.85
120	112.68	135.14	129.48	111.21	100.00	129.24	116.58	123.25	105.26	126.32	104.73

TABLE LIV.

For finding the exact GREENWICH TIME, corresponding to the true LUNAR DISTANCE.

Approximate Interval.		Difference of the proportional Logarithms in the Almanac.																		
		1	2	3	4	5	6	7	8	9	10	20	30	40	50	60	70	80	90	10
h. m.	h. m.	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s	s
0 0	3 0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0 10	2 50	0	0	0	0	0	0	0	1	1	1	1	2	3	3	4	5	5	6	6
0 20	2 40	0	0	0	1	1	1	1	1	1	1	2	4	5	6	7	9	10	11	12
0 30	2 30	0	0	1	1	1	1	1	2	2	2	3	5	7	9	10	12	14	16	17
0 40	2 20	0	0	1	1	1	1	1	2	2	2	4	6	9	11	13	15	17	9	21
0 50	2 10	0	1	1	1	1	2	2	2	2	3	5	7	10	13	15	17	20	23	25
1 0	2 0	0	1	1	1	1	2	2	2	3	3	6	8	11	14	17	19	22	25	28
1 10	1 50	0	1	1	1	1	2	2	3	3	3	6	9	12	15	18	21	24	27	30
1 20	1 40	1	1	1	1	1	2	2	3	3	3	6	9	12	15	19	21	25	28	31
1 30	1 30	1	1	1	1	2	2	2	3	3	3	6	9	12	16	19	22	25	28	31

TABLE LV.

To reduce the Moon's HORIZONTAL PARALLAX and SEMIDIAMETER to any Time under the Meridian of Greenwich.

Diff. in 12 Hours.	Greenwich Time after Noon or Midnight.																Diff. in 12 Hours.
	h. m. 0 10	h m. 0 20	h. m. 0 30	h. m. 0 40	h. m. 0 50	h m. 1 0	h. m. 2 0	h. m. 3 0	h. m. 4 0	h m. 5 0	h. m. 6 0	h. m. 7 0	h. m. 8 0	h m. 9 0	h. m 10 0	h. m. 11 0	
1″	0″	0″	0″	0″	0″	0″	0″	0″	0″	0″	0″	1″	1″	1″	1″	1″	1″
2	0	0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2
3	0	0	0	0	0	0	0	1	1	1	1	2	2	2	3	3	3
4	0	0	0	0	0	0	1	1	1	2	2	2	3	3	3	4	4
5	0	0	0	0	0	0	1	1	2	2	2	3	3	4	4	5	5
6	0	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6	6
7	0	0	0	0	0	1	1	2	2	3	3	4	5	5	6	6	7
8	0	0	0	0	1	1	1	2	3	3	4	5	5	6	7	7	8
9	0	0	0	0	1	1	1	2	3	4	4	5	6	7	8	8	9
10	0	0	0	1	1	1	2	2	3	4	5	6	7	8	8	9	10
11	0	0	0	1	1	1	2	3	4	5	5	6	7	8	9	10	11
12	0	0	0	1	1	1	2	3	4	5	6	7	8	9	10	11	12
13	0	0	1	1	1	1	2	3	4	5	6	8	9	10	11	12	13
14	0	0	1	1	1	1	2	3	5	6	7	8	9	11	12	13	14
15	0	0	1	1	1	1	2	4	5	6	7	9	10	11	13	14	15
16	0	0	1	1	1	1	3	4	5	7	8	9	11	12	13	15	16
17	0	0	1	1	1	1	3	4	6	7	8	10	11	13	14	16	17
18	0	0	1	1	1	1	3	4	6	7	9	11	12	14	15	17	18
19	0	1	1	1	1	2	3	5	6	8	9	11	13	14	16	17	19
20	0	1	1	1	1	2	3	5	7	8	10	12	13	15	17	18	20
21	0	1	1	1	2	2	3	5	7	9	10	12	14	16	18	19	21
22	0	1	1	1	2	2	4	5	7	9	11	13	15	17	18	20	22
23	0	1	1	1	2	2	4	6	8	10	11	13	15	17	19	21	23
24	0	1	1	1	2	2	4	6	8	10	12	14	16	18	20	22	24
25	0	1	1	1	2	2	4	6	8	10	12	15	17	19	21	23	25
26	0	1	1	1	2	2	4	6	9	11	13	15	17	20	22	24	26
27	0	1	1	1	2	2	4	7	9	11	13	16	18	20	23	25	27
28	0	1	1	2	2	2	5	7	9	12	14	16	19	21	23	26	28
29	0	1	1	2	2	2	5	7	10	12	14	17	19	22	24	27	29
30	0	1	1	2	2	2	5	7	10	12	15	17	20	23	25	28	30

TABLE LVI.

LATITUDES AND LONGITUDES

Of the principal Ports, Harbours, Capes, Shoals, Rocks, &c. in the WORLD, founded on several thousand Observations made by the most eminent ASTRONOMERS and NAVIGATORS, compared with the latest and most accurate CHARTS and SURVEYS; to which is occasionally added the Variation of the Compass.

The Longitudes are reckoned from the Meridian of Greenwich.

I. Coast of GREAT BRITAIN, and adjacent Islands.

	(1) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	LONDON, St. Paul's	51	30	49	0	5	47
	Var. 24° 9′, 1824.						
	GREENWICH Obs. . .	51	28	39	0	0	0
					East		
	Gravesend Church .	51	27	39	0	22	10
	Sheerness Flag Staff .	51	26	45	0	44	26
	Var. 24° 30′ *W.* 1823.						
	N. Foreland Light .	51	22	25	1	26	34
	Deal Castle . . .	51	13	5	1	23	59
South Coast of England.	S. Foreland Up. Light	51	8	26	1	22	6
	DOVER Castle . . .	51	7	47	1	19	7
	Folkstone Church . .	51	4	47	1	10	52
	New Romney Church	50	59	7	0	56	22
	Lydd Church . . .	50	57	7	0	54	19
	Dungeness Light . .	50	55	1	0	57	48
	Rye Church . . .	50	57	1	0	44	0
	Hastings	50	52	10	0	38	0
	Beachy Hd. (Station)	50	44	24	0	15	12
					West		
	Brighton Church . .	50	49	32	0	7	40
	Shoreham Church .	50	50	0	0	16	19
	Owers Light . . .	50	39	57	0	39	59
	Selsea Church . . .	50	45	19	0	45	41
	Chichester Church .	50	50	11	0	46	36
	PORTSMOUTH Church	50	47	27	1	5	57
	— Academy . . .	50	48	4	1	5	59
	Var 24° 15′ *W.* 1813.						
	South-Sea Castle . .	50	46	44	1	5	2
	Calshot Castle . . .	50	49	7	1	18	6
	——						
I. of Wight.	Cowes	50	45	37	1	16	15
	Bembridge Point . .	50	40	59	1	4	51
	Dunnose (Station) .	50	37	9	1	11	36
	St. Catherine's Tower	50	35	34	1	17	51
	Needles Light . .	50	39	54	1	33	55
	——						
	Hurst Castle . . .	50	42	25	1	32	45
	Christ-Church Head .	50	42	38	1	44	31
South Coast of England.	Poole Church . . .	50	42	51	1	58	55
	St. Aldan's Head . .	50	35	0	2	3	20
	Weymouth	50	36	0	2	27	0
	Portland Up. Light .	50	31	23	2	26	49
	Bridport	50	42	20	2	43	30
	Lyme Cobb . . .	50	43	11	2	55	29
	Exmouth Bar . . .	50	36	40	3	21	30
	Torbay, Bob's Nose .	50	27	50	3	26	43
	— Berry Head . .	50	24	2	3	28	14
	Dartmouth	50	19	40	3	35	30
	Start Point, flagstaff .	50	13	27	3	38	21
	Praule Point . . .	50	13	15	3	42	30
	Bolt Head (Station) .	50	13	45	3	48	3

	(2) Places.	Lat. N.			Lon W		
		°	′	″	°	′	″
	Eddystone Light . .	50	10	54	4	15	3
	Mewstone	50	18	30	4	5	33
	PLYMOUTH, New Ch.	50	22	21	4	7	16
	— Old Church . .	50	22	15	4	7	32
	Drake's Island . . .	50	22	4	4	8	18
South Coast of England.	Penlee Beacon . .	50	19	25	4	10	40
	Rame Head (flagstaff)	50	18	53	4	12	29
	Fowey	50	20	7	4	37	31
	Deadman's Pt. (flag.)	50	13	21	4	47	4
	FALMOUTH,						
	— St. Anthony's Hd.	50	8	35	4	59	31
	— Pendennis Castle .	50	8	50	5	1	44
	Blackhead, flagstaff .	50	1	13	5	3	59
	LIZARD upper Light .	49	57	41	5	11	5
	Mount's Bay . . .						
	— St. Michael's Mt.	50	7	2	5	27	33
	— St. Paul's Steeple	50	5	26	5	31	37
	St. Leven's Point . .	50	3	54	5	41	4
	Rundlestone Beacon .	50	1	30	5	39	0
	Wolf Rock	49	55	45	5	48	0
	Longship's Light . .	50	4	2	5	43	33
	Land's End Stone .	50	4	8	5	41	31
	——						
	Scilly Islands,						
	— St. Agnes' Light .	49	53	37	6	19	23
	— St. Mary's Fort .	49	55	0	6	17	57
	— St. Martin's D.Mk.	49	58	4	6	14	39
	Var. 27° 30′ W. 1814.						
	The Seven Stones .	50	2	30	6	6	0
	Cape Cornwall . .	50	8	0	5	41	0
	St. Ives	50	13	0	5	28	0
	St. Agnes Beacon . .	50	18	27	5	11	56
West Coast of England.	Trevose Head . . .	50	32	57	5	0	54
	Padstow	50	35	0	4	55	0
	Tintagel Head . . .	50	40	0	4	45	0
	Hartland Point . .	51	1	22	4	30	26
	Mort Point	51	11	0	4	13	0
	Lundy I. Light . .	51	10	5	4	39	20
	Flatholm Light . .	51	22	33	3	6	25
	Bridgewater Church .	51	7	41	2	59	39
	BRISTOL Cathedral .	51	27	6	2	35	29
	Nash Point	51	24	30	3	33	0
	Mumbles Pt. and Lt.	51	34	0	3	57	20
	Worms Head . . .	51	33	56	4	18	56
	Pembrey Church . .	51	41	18	4	15	28
	Caldy Island . . .	51	37	0	4	40	0
	St. Gcwan's Point .	51	36	0	4	56	0
	St. Ann's Light . .	51	40	59	5	9	19
	Milford Church . .	51	42	43	5	0	39
	Hubberstone Church .	51	42	56	5	2	7
	Smalls Light . . .	51	43	18	5	38	54
	Grasholm	51	43	55	5	27	32
	Ramsey Isle . . .	51	51	43	5	19	36
	St. David's Cathedral	51	52	56	5	14	53

TABLE LVI.

LATITUDES AND LONGITUDES.

	(3) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
West Coast of England.	Bishop and Clerks	51	54	10	5	21	58
	Strumble Head	52	1	30	5	6	0
	Dinas Point	52	2	0	4	53	0
	Cardigan Harbour	52	7	0	4	42	0
	Aberistwith	52	25	0	4	6	0
	Barmouth, entr.	52	44	0	4	5	0
	Bardsey I. Light	52	46	0	4	46	0
	Brachy Pool Head	52	48	0	4	45	0
	Holyhead Island,						
	— Signal Tower	53	19	6	4	39	39
	Skerries Light	53	25	0	4	37	0
	Point Linas, Light	53	25	0	4	17	0
	Great Ormes Head	53	20	2	3	50	21
	Point of Air Light	53	21	28	3	18	35
	Helbre Light	53	23	34	3	10	13
	Leasows Light	53	24	50	3	6	49
	LIVERPOOL, St. Paul's	53	24	40	2	58	55
	Formby Point	53	32	34	3	5	2
	Lancaster Church	54	3	8	2	47	41
	St. Bees Head Light	54	30	55	3	37	24
	Whitehaven	54	32	50	3	34	56
	CARLISLE	54	56	0	2	54	0
	Annan Church	54	59	23	3	14	45
	—						
Isle of Man.	Air Point Light	54	26	0	4	23	0
	Douglas	54	9	30	4	29	0
	Castletown	54	5	0	4	39	0
	The Calf Light	54	2	30	4	48	0
	Peele Light	54	13	30	4	41	0
	—						
West and North Coasts of Scotland.	Ross Head	54	47	0	4	6	0
	Burrow Head	54	40	45	4	23	30
	Mull of Galloway	54	38	9	4	51	20
	Port Patrick Light	54	49	0	5	5	0
	Lough Ryan, entr.	55	3	0	5	6	0
	Air Lights	55	28	30	4	37	0
	Irvine	55	38	0	4	38	0
	Ailsa Island	55	15	14	5	7	0
	Cumray I. Light	55	45	0	4	54	0
	Greenock	55	57	0	4	44	30
	GLASGOW	55	51	32	4	16	0
	Pladda Light	55	25	30	5	7	0
	Mull of Cantire Light	55	18	50	5	46	0
	Tonvore Head	55	54	0	6	28	0
	Runs Point Light	55	46	0	6	28	0
	Skerryvore Rocks	56	17	0	7	1	0
	Dusker Rock	56	34	0	6	58	0
	Coll Island, N. end	56	42	0	6	24	0
	Rum Island, S. end	56	55	0	6	15	0
	Helsker Island	56	56	0	6	38	0
	Dunvegan Head	57	30	0	6	43	0
	Rea Head	57	50	0	5	43	0
	More Head	58	5	0	5	19	0
	Stower Head	58	14	0	5	18	0
	Cape Wrath Light	58	38	30	4	57	0
	Var. 30° *W.*						
	Nun Rock	58	52	30	4	56	0
	Rona Island	59	7	0	5	49	0
	Barra Island	59	5	30	6	9	0
	Farout Head	58	37	30	4	47	0
	Dunnet Head	58	42	0	3	26	0

	(4) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Duncansby Head	58	39	45	3	6	20
	Var. 30° *W.*						
	—						
Hebrides or Lewis Isl.	Barra Head	56	47	0	7	38	0
	South Uist, S. end	57	4	0	7	14	0
	Renish Head	57	41	0	6	57	0
	Glash I. Light	57	50	0	6	37	0
	Aird, N. Point	58	15	0	6	5	0
	Butt of Lewis	58	31	0	6	13	30
	Gallen Head	58	11	0	7	4	0
	Flannen Isles	58	18	0	7	31	0
	St. Kilda	57	49	30	8	32	30
	Hyskar Island	57	38	0	7	41	0
	Rockall	57	39	32	13	31	16
	—						
Orkney Islands.	Pentland Skerries, Lts.	58	42	0	3	2	0
	Stroma Isle, S. end	58	41	0	3	14	0
	S. Ronaldsha, Old Hd.	58	44	30	3	1	20
	Copinsha	58	55	20	2	46	0
	Kirkwall Road	58	59	0	3	4	0
	Stronsa I., Lamb Head	59	4	0	2	39	0
	Start Point Light	59	16	30	2	22	0
	North Ronaldsha,						
	— Dennisness	59	22	30	2	22	0
	Papa Westra Isle,						
	— Moul head	59	21	0	3	3	0
	Westra I., Noup Head	59	18	30	3	12	0
	Pomona Island,						
	— Marwick Head	59	6	0	3	25	0
	— Stromness, town	58	56	56	3	24	0
	Var. 27° 50′ *W.* 1821.						
	Hoy Head	58	55	0	3	28	30
	Sule Skerry	59	3	0	4	15	0
	Stack	59	1	30	4	18	0
	Fair Island	59	30	0	1	47	0
	—						
Shetland Islands.	Sumbro Head Light	59	51	15	1	17	0
	Hangcliff or Noss Hd.	60	8	20	1	0	20
	LERWICK, Fort	60	9	30	1	8	40
	Brassa I., S. Point	60	6	10	1	4	30
	Rumble Island	60	20	0	0	54	30
	Out Skerries, E. end	60	25	30	0	43	40
	Balta I., mid.	60	45	0	0	47	20
	Lambaness	60	49	0	0	45	30
	Var. 27° 40′ *W.*						
	Ronas Hill	60	32	0	1	26	0
	Ossa Skerry	60	33	0	1	35	40
	Voe Skerries	60	22	20	1	49	0
	Foul Island, N. Pt.	60	9	30	2	5	0
	—						
Faroe Islands.	Monk Rock	61	23	0	6	52	15
	Suderoe, S. end	61	26	20	6	53	0
	Great Diamond	61	44	0	6	53	30
	Sandoe, S. end	61	47	15	6	48	0
	Stromoe, Thorshaven	62	2	10	6	50	30
	Fugloe	62	20	40	6	18	0
	Mygenas I. W. end	62	8	0	7	42	30
	Var. 30° *W.* 1818.						
	—						
	Noss Head	58	30	0	3	9	0
	Clyth Ness	58	20	0	3	16	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(5) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
East Coast of Scotland.	Ord Head	58	10	0	3	37	0
	Tarbett Ness	57	54	0	3	47	0
	Cromartie	57	42	0	4	1	0
	INVERNESS	57	31	0	4	12	0
	Fort St. George	57	37	0	4	5	0
	Burgh Head	57	43	0	3	30	0
	Cousy Point	57	44	0	3	17	0
	Cullen	57	42	0	2	50	0
	Bamff	57	40	0	2	32	0
	Kinnaird's Head	57	41	40	2	1	0
	Ratrie Head	57	38	0	1	50	0
	Peter Head	57	32	0	1	47	0
	Buchan Ness Light	57	29	15	1	47	0
	Var. 28° *W.*						
	Newburgh	57	20	0	2	3	0
	NEW ABERDEEN, obs.	57	9	0	2	8	0
	Girdleness	57	8	0	2	6	0
	Stonehaven	56	58	0	2	13	0
	Tod Head	56	53	0	2	15	0
	Montrose Ness	56	42	10	2	27	15
	Red Head	56	38	0	2	28	0
	Arbroath	56	34	0	2	35	0
	Button Ness and Lts	56	28	0	2	44	15
	DUNDEE	56	28	0	2	57	30
	Inch Cape Light, or Bell Rock	56	26	40	2	22	45
	St. Andrew's Church	56	20	40	2	47	0
	Fife Ness	56	17	0	2	34	30
	Elie Ness	56	11	20	2	48	0
	Kinghorn Ness	56	4	0	3	10	0
	Inchcolm	56	2	0	3	17	0
	EDINBURGH, Coll.	55	56	57	3	10	30
	Leith Pier	55	58	50	3	10	0
	Var. 27° 45′ *W.*						
	Inch Keith Light	56	2	15	3	7	30
	Fidra	56	4	30	2	46	30
	North Berwick, Law	56	3	8	2	42	11
	May I. and Light	56	11	22	2	32	47
	Var. 28° 15′ *W.*						
	The Bass Rock	56	4	53	2	37	47
	DUNBAR	56	0	30	2	30	20
	St. Abb's Head	55	55	30	2	8	0
	Eyemouth	55	52	42	2	4	45
East Coast of England.	Berwick	55	46	21	1	59	41
	Holy Island Castle	55	40	20	1	46	38
	Bamburgh Castle	55	36	42	1	42	8
	Staples Light	55	38	9	1	37	5
	Fern I. Light	55	37	11	1	38	51
	Sunderland Point	55	34	45	1	37	56
	Coquet Island, — Tower	55	20	11	1	31	47
	Tynemouth Light	55	1	21	1	24	31
	Sunderland Light	54	55	12	1	21	16
	Hartlepool Church	54	41	49	1	10	31
	River Tees, entrance	54	38	0	1	5	0
	Stockton	54	33	0	1	14	0
	WHITBY	54	28	30	0	35	20
	Scarborough	54	18	0	0	23	0
	Filey Brig	54	14	0	0	14	0
	Flambro' Head Light	54	7	50	0	2	20
	Var. 25° *W.* 1828.						

	(6) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
East Coast of England.	Spurn Lights	53	34	44	0	7	9
	Lynn Regis	52	45	23	0	25	4
	Hunstanton Light	52	57	8	0	29	41
	Outer Dowsing, mid.	53	30	0	0	55	0
	Haddocks Bank, mid.	53	32	0	1	40	0
	Dudgeon Light	53	19	0	0	55	0
	Inner Dowsing, N.end	53	20	0	0	34	0
	Cromer Inner Bk. mid.	53	9	0	1	24	0
	Lemon, North Elbow	53	8	0	1	54	0
	Sherringham Shs E. end	53	2	0	1	15	30
	Smith's Knowl, mid.	52	53	0	2	16	0
	Cromer Light	52	55	20	1	19	30
	Hasborough Lights	52	49	0	1	33	0
	Winterton	52	44	15	1	42	0
	YARMOUTH Church	52	36	40	1	43	22
	Leostoff High Light	52	29	10	1	45	14
	Southwold Church	52	20	0	1	40	0
	Aldbro' Knaps	52	8	0	1	42	0
	Orfordness Light	52	5	0	1	34	14
	Landguard Fort	51	56	18	1	19	4
	Harwich Church	51	56	43	1	17	8
	Walton To. on the Naze	51	51	51	1	17	7
	Galloper Light Vessel	51	44	30	1	53	30
	Inner Garbard Buoy	51	56	0	1	56	0
	Outer Garbard Buoy	51	58	40	2	3	45

II. COAST OF IRELAND.

					West		
West Coast of Ireland.	CAPE CLEAR Light	51	24	55	9	29	0
	Fastnet Rock	51	22	0	9	37	0
	Crookhaven entr.	51	27	0	9	43	0
	Mizen Head	51	26	0	9	51	0
	Bantry Bay — Sheep's Head	51	31	0	9	52	0
	Crow Point	51	34	0	10	12	0
	Dursev I. W. end	51	34	0	10	15	0
	Kenmare Harbour — Cod's Head	51	40	0	10	7	0
	— Lamb's Head	51	44	0	10	8	0
	Var. 2¾ *Points W.*						
	Hog Islands	51	44	0	10	17	0
	Bolus Head	51	46	0	10	24	0
	Skellig Rks. and Lts.	51	46	0	10	34	0
	Dingle Bay — Bray Head	51	52	0	10	29	0
	— Valentia Harb. ent.	51	55	0	10	20	0
	— Dunmore Head	52	6	0	10	32	0
	Foze Rock	52	1	15	10	41	50
	Ferriter's Island	52	2	30	10	38	0
	Tiraght Rocks	52	4	0	10	40	0
	Gt Blaskett, W. end	52	3	30	10	36	0
	Ennis Tuskar	52	8	0	10	36	0
	Dunorling Head	52	11	0	10	28	0
	Brandon Head	52	17	0	10	10	0
	Shannon Mouth, — Kerry Head	52	27	0	9	53	0
	— Loop Head	52	34	0	9	52	28
	LIMERICK	52	39	0	8	33	0
	Clare	52	47	0	8	53	0
	Hags Head	52	59	0	9	18	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(7) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
West Coast of Ireland.	Galway Bay,						
	— Black Head . . .	53	10	0	9	6	0
	— GALWAY. . . .	53	17	0	8	51	0
	N. Arran I. Light. .	53	8	0	9	35	0
	Skird Rocks. . . .	53	16	0	9	55	0
	Sline Head	53	27	0	10	7	0
	Shark Island . . .	53	38	0	10	10	0
	Ennis Turk I. . . .	53	45	0	10	0	0
	Clare I. Light . . .	53	51	0	9	52	0
	Achill Head	54	0	0	10	8	0
	Black Rock	54	4	0	10	17	0
	—						
North Coast of Ireland.	Broad Haven,						
	— Urris Head . . .	54	17	15	9	58	10
	Stag Rocks	54	21	0	9	47	0
	Downpatrick Head .	54	20	0	9	21	0
	Killala	54	13	0	9	14	0
	SLIGO.	54	16	20	8	26	0
	Ennis Murry . . .	54	26	0	8	38	0
	Donegal	54	37	0	8	7	0
	St. John's Cape . .	54	38	0	8	28	0
	Tillen Head	54	41	0	8	49	0
	Daurus Head . . .	54	49	0	8	34	0
	Arranmore I. Light .	55	0	0	8	32	0
	Bloody Foreland . .	55	9	30	8	16	0
	Tory Island, N. W. Pt.	55	16	30	8	15	20
	Horn Head	55	13	40	7	59	0
	Melmore Head. . .	55	16	30	7	47	30
	Loch Swilly,						
	— Pt. Fannett Light.	55	16	30	7	38	0
	— Dunaff Head. . .	55	17	10	7	32	0
	Mullin Head . . .	55	22	30	7	24	30
	Ennistrahul Light. .	55	26	0	7	14	0
	Var. 30° *W.*						
	Inishone Head. . .	55	14	40	6	56	0
	LONDONDERRY . .	54	59	28	7	20	0
	Giants' Causeway. .	55	14	30	6	31	30
	Rachlin I., W. end .	55	17	35	6	17	40
	Fair Head	55	13	35	6	9	20
	Tor Head.	55	11	50	6	4	6
	—						
East Coast of Ireland.	Maiden Rks. E. Light	54	55	40	5	44	0
	Black Head. . . .	54	46	0	5	41	50
	Carrickfergus . . .	54	42	40	5	49	10
	BELFAST.	54	36	0	5	56	20
	Mew I. and Light. .	54	41	40	5	32	0
	South Rock Light. .	54	23	55	5	25	30
	Ardglass Light. . .	54	15	0	5	38	20
	Dundrum, Entrance .	54	14	0	5	49	30
	Cranfield Light. . .	54	1	10	6	5	40
	Dundalk, Soldiers' Pt.	54	15	0	6	21	50
	Clougher Head. . .	53	47	40	6	14	0
	Drogheda Bar . . .	53	43	20	6	15	10
	St. Patrick's Island .	53	35	0	6	5	10
	Lambay Island. . .	53	29	12	6	2	0
	Howth Head Light .	53	21	30	6	4	30
	DUBLIN Light . .	53	21	13	6	5	13
	— Observatory. . .	53	23	13	6	20	30
	Var. 26° 30′ *W.*						
	Wicklow Lights . .	52	59	9	5	58	0
	Arklow	52	50	0	6	5	30
	Glascarrick Point . .	52	36	0	6	8	0
	WEXFORD Harb. Ent.	52	22	0	6	18	0

	(8) Places.	Lat. N.			Lon. W.		
	—	°	′	″	°	′	″
	Carnsore Point . .	52	11	30	6	18	0
	Tuskar Rock & Light.	52	13	0	6	7	0
	Saltees Rocks . . .	52	6	0	6	34	0
South Coast of Ireland.	Hook Light. . . .	52	5	0	6	54	0
	WATERFORD . . .	52	12	0	7	6	0
	Tramore	52	7	0	7	7	0
	Dungarvan	52	3	0	7	34	0
	Helwick Head . . .	51	59	30	7	27	0
	Youghal	51	53	0	7	51	0
	Roche's Pt. and Light	51	46	0	8	11	0
	CORK	51	53	54	8	28	0
	Var. 28° *W.*						
	Kinsale Light . . .	51	37	0	8	27	0
	Seven Heads . . .	51	35	0	8	39	0
	Gally Head	51	33	0	8	50	0
	Ross	51	35	0	8	56	0
	Stags, off Toe Head .	51	26	0	9	10	0
	BALTIMORE. . . .	51	28	0	9	20	0

III. Coast of LAPLAND & NORWAY,

From Nova Zembla to the Naze.

					East.		
	Nova Zembla, N. Pt.	77	4	0	77	5	0
	Weigates Strait. . .	69	10	0	60	0	0
	—						
	Cape Candinose . .	68	39	10	43	32	34
	Cape Konochin. . .	67	12	0	43	48	0
	Morshovets Is., S. Pt.	66	40	0	42	41	0
	Cape Voronou or						
	Good Fortune . .	66	31	0	42	18	0
	Cape Katness . . .	65	26	0	39	43	0
White Sea.	ARCHANGEL, out. Rd.	64	57	0	40	6	0
	— City	64	34	30	40	33	40
	Var. 1° 30′ *E.*						
	Cape Donega . . .	65	8	0	36	52	0
	Pushlackta Bay, entr.	64	50	0	36	30	0
	Onega.	63	53	36	38	8	30
	Anger Island, E. end.	65	9	0	36	19	0
	Kandalax.	67	8	0	32	26	0
	Cross Island. . . .	66	29	0	40	43	0
	Ponoi	67	4	30	41	7	15
	Cape Orlogeness . .	67	12	0	11	22	0
	Cape Sweetnose . .	68	10	0	39	47	0
	Var. 1° *W.*						
	—						
Coast of Norway & Lapland.	Nagel Island, N. end.	68	25	0	38	27	0
	Kilduin Island W. end	69	22	0	33	50	0
	Kola	68	52	28	33	0	45
	Wardhuys Island . .	70	22	36	31	6	45
	NORTH CAPE . . .	71	10	15	25	50	45
	Hammerfest,						
	— Fugleness Point .	70	39	51	23	43	15
	Var. 11° 26′ *W.*						
	Altengaard	69	55	0	23	4	15
	Sand-oe	68	56	15	16	49	45
	Loffoden Isles,						
	— Wœroe or Werro I.	67	38	0	12	38	0
	— Rost Island . . .	67	31	0	12	7	0

LATITUDES AND LONGITUDES.

	(9) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Vigten Isles,						
	— Soroe	64	44	30	10	50	0
	Halten Isles, middle .	64	11	0	9	22	0
	Froyen, S. W. end .	63	40	30	8	16	0
Coasts of Norway and Lapland.	DRONTHEIM	63	25	50	10	23	25
	Var. 22° 30′ W.						
	Griboerne, middle .	63	14	0	7	34	0
	Christiansund . . .	63	7	0	7	42	0
	Lingvan Fiord, entr. .	62	57	0	6	47	0
	Haaevaer Sund, entr.	62	52	0	6	26	0
	Nogva Fiord, entr. .	62	43	0	6	10	0
	Molde	62	44	0	7	8	30
	Rondoe Lighthouse .	62	24	30	5	35	30
	Stadt Land, N.W. Pt.	62	11	30	5	7	30
	Froe Soen, entrance .	61	41	30	4	49	0
	Tempa Bank, mid. .	61	27	0	4	31	0
	Bueland, N. W. end .	61	17	30	4	37	0
	Aspo I., N. end . .	61	13	0	4	44	0
	Udver Isles . . .	61	2	0	4	28	0
	Blomoe	60	32	0	4	46	30
	BERGEN Castle . .	60	24	0	5	18	0
	Var. 24° 45′ W.						
	Kors Fiord, entrance	60	8	30	5	1	0
	Fugloe	60	1	0	4	59	0
	Selboe Ficrd, entr. .	59	57	0	5	2	0
	Bommel-oe, S. end .	59	35	0	5	13	0
	Skudesnaes Light .	59	8	40	5	19	0
Norway.	Hviddings-oe Light .	59	3	50	5	24	30
	Stavanger	58	58	30	5	45	0
	Var. 2 points W.						
	Jedderen Reef . .	58	45	40	5	29	0
	Lister Land, W. Pt.	58	5	40	6	36	0
	Markoe Light . . .	57	59	0	6	59	0
	Lindernœs or NAZE Lt.	57	57	50	7	3	15
	Var. 22° 30′ W.						

IV. The CATTEGAT and SOUND.

	SKAGEN or SCAW Light	57	43	44	10	37	30
	Fladstrand	57	27	3	10	33	15
	Sæbye	57	20	2	10	33	9
Jutland.	Aalborg	57	2	32	9	56	41
	Grenaae	56	24	57	10	53	59
	Aarhuus	56	9	35	10	14	5
	Apenrade	55	2	57	9	26	38
	Flensborg	54	47	18	9	27	40
	Sleswick	54	31	27	9	33	57
	LINDERNÆS or NAZE Lt.	57	57	50	7	3	15
	Mandal	58	0	40	7	28	30
	Fleckeroe Haven . .	58	5	0	8	2	0
	Christiansand . . .	58	8	4	8	3	0
	Arendal	58	27	0	8	51	20
Norway.	Oster Risoer . . .	58	42	30	9	19	30
	Krageroe	58	51	30	9	30	30
	Friderichsværn . .	58	59	0	10	7	0
	Færder Light . . .	59	3	30	10	36	20
	Fulehuk Light . . .	59	10	20	10	40	0
	Agero Fort	59	2	35	10	57	0
	CHRISTIANIA . . .	58	55	20	10	48	30
	Friderichstad . . .	59	12	0	11	1	0

	(10) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Stromstad	58	56	0	11	15	0
	Salœ Light	58	21	0	11	15	30
	Paternosters, S.W. end	57	53	30	11	28	0
	Marstrand Light . .	57	53	51	11	36	0
	GOTHENBURG . . .	57	42	4	11	57	45
	Wingoe Beacon . .	57	38	13	11	37	40
	Vanguard Shoal . .	57	32	30	11	39	0
	Tislerne	57	31	0	11	44	0
	Niddingen Lights .	57	18	30	11	55	0
Sweden.	Warberg	57	6	18	12	16	0
	Falkenberg	56	54	30	12	30	0
	Halmstad	56	39	45	12	51	45
	Laholm	56	32	38	13	0	45
	Hollands Wadero,						
	—South end . . .	56	26	0	12	35	0
	Engelholm	56	14	20	12	54	0
	Koll Light	56	18	3	12	27	32
	Helsingborg . . .	56	2	55	12	43	0
	Landskrona	55	52	27	12	50	46
	Lunden, Obs. . . .	55	42	26	13	12	27
	Malmo	55	36	37	13	1	19
	Falsterbo Light . .	55	23	8	12	49	17
	Steffen's Head Light	55	17	30	12	27	0
	Kioge	55	27	40	12	11	0
	COPENHAGEN obs.	55	41	4	12	35	6
	Var. 19° W.						
Zeeland.	ELSINEUR	56	2	17	12	37	0
	Cronborg Castle & Lt.	56	2	22	12	37	40
	Nakke Head Lights .	56	7	0	12	21	0
	Nykiobing	55	55	0	11	40	30
	Callundborg . . .	55	40	54	11	6	18
	Corsoer	55	19	30	11	9	30
	Wordingborg . . .	55	0	30	11	56	0
Is. in Cattegat, Sound, and Belt.	Huen I. Uranienberg	55	54	38	12	42	59
	Amag Island, Drago .	55	36	0	12	41	0
	Hassen Island . . .	56	11	46	11	42	30
	Sproe Island Light .	55	20	0	10	59	0
	Moen I. Speil Cliff .	54	58	0	12	33	44
	Falster I. Geedesbye						
	or Trindelen Light .	54	34	16	11	59	0
	Anholt Light . . .	56	44	20	11	39	50
	Great Middle Ground	56	34	0	12	5	0
	Little Middle Ground	56	57	20	11	59	0
	Lessoe, East end . .	57	19	0	11	11	30
	— West end . . .	57	16	0	10	53	0
	Trindelen Rock . .	57	25	30	11	15	0

V. The BALTIC.

	Fyen, Odense . . .	55	28	30	10	24	0
	— Fyen Head . . .	55	37	0	10	38	0
Danish Isles.	— Knudes Head . .	55	17	40	10	52	0
	Langeland, N. end .	55	20	0	10	57	0
	— S. end, Light . .	54	44	0	10	44	0
	— Rudkiobing . .	54	56	30	10	44	0
	Æroe, Kiobing . .	54	53	0	10	25	0
	Alsen, Sonderborg .	54	54	59	9	48	20
	Laaland, Naskoi . .	54	50	0	11	10	0
	Falster, Nyekiobing .	54	46	0	11	53	30

TABLE LVI.

LATITUDES AND LONGITUDES.

	(11) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Moen, Steege	54	59	30	12	18	0
	Femeren, Borg	54	28	0	11	13	0
	—						
Sweden.	Trelleborg	55	23	0	13	10	0
	Ystad	55	25	52	13	50	1
	Cimbritshamn Church	55	33	40	14	19	19
	Ahus	55	55	30	14	16	20
	Hano	56	1	2	14	48	25
	Carlshamn	56	10	30	14	50	0
	Terno, S. end	56	6	51	14	56	25
	Carlskrona Gt. Ch.	56	10	9	15	33	26
	Utklipporne Rocks	55	56	35	15	39	51
	Torum Point	56	4	0	15	48	0
	Calmar Church	56	40	29	16	21	44
	Westerwyk	57	45	0	16	37	0
	Sparo Beacon	57	42	16	16	42	55
	Haradskar Beacon	58	8	4	16	58	25
	Arko, Stangskar	58	28	10	16	59	55
	Hafringe Beacon	58	36	0	17	18	2
	Landsort Lighthouse	58	44	28	17	51	45
	Dalaro, entrance to	59	6	55	18	24	3
	STOCKHOLM obs.	59	20	31	18	3	45
	Korso Light	59	17	20	18	57	53
	Gronskars Light	59	17	0	19	12	30
	Svenskahogar	59	27	0	19	30	0
	Soderarm Beacon	59	45	22	19	24	5
	—						
Germany.	Keil	54	19	43	10	8	18
	Lubec	53	51	18	10	49	52
	Wismar	53	51	30	11	39	0
	Rostock	54	3	0	12	11	0
	Dars Head	54	30	0	12	30	0
	Stralsund	54	19	28	13	7	5
	Wollin	53	51	0	14	37	0
	Stettin	53	26	0	14	33	0
	Camin	53	59	0	14	45	0
	Colberg, Bar	54	10	50	15	37	44
	Rugenvalde, entr. to	54	25	0	16	25	0
	—						
Prussia.	Reserhooft Light	54	50	4	18	18	30
	Heel Light	54	35	10	18	48	22
	Dantzig	54	20	48	18	38	5
	Pillau Light	54	38	12	19	53	59
	Konigsberg	54	42	12	20	29	15
	Brusterort Lights	54	57	36	19	59	1
	Memel	55	41	42	21	7	59
	Libau	56	31	10	20	56	25
	Windau	57	24	30	21	31	0
	Lyserort	57	34	0	21	40	0
	Domesness Lights	57	46	12	22	31	59
	—						
Russia.	Runo I., Light	57	48	1	23	11	0
	Riga Church	56	56	5	24	0	4
	Dunamnude Lights	57	1	35	23	55	1
	Pernau	58	21	0	24	25	0
	—						
	Dago, Dagerort Hd	58	56	5	22	0	37
	— Dagerort Light	58	55	9	22	10	12
	Filsand Light	58	23	0	21	46	0
	Oesel, Palmerort	58	39	0	22	30	0
	— Hundsort	58	31	0	21	53	0
	— Svartverort Light	57	55	0	22	1	8

	(12) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
Islands in the Baltic.	— Arensberg	58	15	9	22	27	45
	Gottska Sando, — Nybygget	58	20	57	19	13	17
	Faro, Holm Head	57	57	30	19	23	10
	Gottland, — Halshuk	57	55	27	18	43	54
	— Wisby	57	38	50	18	16	21
	— Little Carlso	57	19	39	18	4	36
	— Great Carlso	57	18	0	17	58	0
	— Hoborg	56	55	9	18	7	32
	— Farosund	57	51	48	19	4	20
	Ostergarnsholm Light	57	26	10	19	0	0
	Oland, North Head	57	22	30	17	6	30
	— South Head Light	56	12	3	16	23	9
	Eartholms, Christian Oe Light	55	19	9	15	11	12
	Bornholm, Hammeren Light	55	17	39	14	46	13
	— Ronne Church	55	6	16	14	41	53
	— Due Odde	54	59	6	15	5	27
	— Svaneke Church	55	7	54	15	8	40
	Rugen, Arcona	54	41	4	13	27	53
	— Bergen Church	54	25	32	13	27	44
	— S. E. end	54	16	30	13	45	0

VI. The Gulfs of FINLAND and BOTHNIA.

S. Coast of the Gulf of Finland.	Dago I., Dagerort Hd.	58	56	5	22	0	37
	— Dagerort Light	58	55	9	22	10	12
	Odensholm Light	59	17	56	23	20	58
	Packerort Light	59	24	20	24	2	0
	Surop Head	59	28	30	24	20	0
	Nargen I., N. Point	59	36	1	24	28	23
	Revel, St. Olai Ch.	59	26	11	24	42	8
	Kokskar Light	59	41	30	24	57	0
	Ekholm Light	59	41	20	25	43	30
	Stoneskar Beacon	59	49	30	26	18	0
	Rotskar Light	59	59	0	26	37	0
	Little Tyters, N.W. end	59	50	0	26	48	0
	Great Tyters, S. end	59	51	0	27	7	0
	Narva Lighthouse	59	28	0	28	1	0
	Lavenskar, Kupka	60	1	0	27	44	0
	Seskar Lighthouse	60	1	30	28	17	0
	Dolgoinoss	59	51	0	28	54	0
	Tollbaken Light	60	3	38	29	32	33
	Cronstadt	59	59	26	29	47	30
	PETERSBURG, Obs	59	56	31	30	17	33
	—						
N. Coast of the G. of Finland.	Wiburg	60	42	40	28	46	5
	Nervo Tower	60	14	0	27	53	0
	Sommar Lighthouse	60	12	0	27	34	0
	Aspo Beacon	60	17	32	27	8	2
	Hogland North Light	60	6	31	26	53	21
	Lovisa Church	60	27	38	26	10	40
	Orrenground Beacon	60	16	35	26	23	1
	Great Pellinge, S side	60	12	23	25	48	43
	Sandkallan Rock	60	2	35	25	44	45
	Helsingfors	60	10	50	24	58	0
	Ronskar Lighthouse	59	55	28	24	22	8
	Great Jussari	59	49	43	23	33	12

TABLE LVI.

LATITUDES AND LONGITUDES.

	(13) Places.	Lat. N. °	′	″	Lon. E. °	′	″
	Hango Beacon . . .	59	46	20	22	57	45
	Abo Great Church .	60	26	58	22	17	0
	Uto Lighthouse . .	59	46	40	21	19	45
	Enskar Light . . .	60	14	0	19	14	0
	Svartklubben Light .	60	11	0	18	44	0
	Oskaret Light . . .	60	32	0	18	15	0
	Gefle	60	39	45	17	0	0
Gulf of Bothnia.	Soderhamn	61	17	0	16	56	0
	Bremon, N. end . .	62	13	0	17	36	0
	Hernosand	62	38	0	17	47	0
	Gadden Light . . .	63	36	0	20	40	0
	Tornea	65	50	50	24	9	0
	Uleaborg	65	3	0	25	30	0
	Brahestad	64	41	0	24	31	0
	Ny Carleby	63	33	0	22	32	0
	Wasa	63	6	0	21	36	0
	Christinestad . . .	62	16	0	21	15	0
	Nystad	60	49	0	21	23	0

VII. Coasts of DENMARK, GERMANY, HOLLAND, and NETHERLANDS.

From the Scaw to Calais.

Denmark.	Scaw Light . . .	57	43	44	10	37	30
	Robsnout	57	25	0	9	45	0
	Oester Head . . .	57	10	0	8	58	0
	Holmen	57	8	0	8	37	30
	Point Horn	55	34	15	8	5	0
	Helegoland Light . .	54	11	31	7	53	13
	Elbe R., Red Buoy .	53	59	10	8	20	15
	Var. 20° W.						
	Nework	53	55	19	8	31	24
Germany.	Cuxhaven	53	52	21	8	43	10
	Glukstadt	53	47	42	9	27	2
	Stade	53	36	32	9	28	31
	Hamburgh	53	32	51	9	58	22
	Bremerlehe . . .	53	33	28	8	34	30
	Bremen	53	4	38	8	48	0
	Wrangeroog Light .	53	48	26	7	52	35
	Borcum Light . . .	53	36	0	6	38	0
	Emden	53	22	3	7	11	1
	Gottingen Obs. . .	51	31	50	9	56	30
	Ter Schelling, W. end	53	22	30	5	12	0
	Harlingen	53	10	32	5	24	47
	Entr. to Texel,						
	— Kyk Down Fort .	52	57	3	4	43	10
	Alkmaar	52	37	11	4	45	0
	AMSTERDAM . .	52	22	17	4	53	15
Holland.	Haarlem	52	22	56	4	38	19
	Leyden	52	9	30	4	29	13
	The Hague	52	4	50	4	18	47
	Holland's Hook . .	51	57	0	4	5	0
	Rotterdam . . .	51	54	4	4	27	50
	Var. 24° W.						
	Briel	51	54	30	4	9	25
	Hellevoetsluys . .	51	49	42	4	7	35
	Goeree	51	49	15	3	59	36

	(14) Places.	Lat. N. °	′	″	Lon. E. °	′	″
	Walcheren,						
	— West Cappel Light	51	31	45	3	26	55
	Middleburg . . .	51	30	6	3	37	30
	Flushing	51	26	42	3	34	57
	Antwerp	51	13	16	4	24	10
	Sluys	51	18	35	3	23	9
Netherlands.	Bruges	51	12	33	3	13	33
	Ostend	51	13	57	2	55	8
	Nieuport	51	7	54	2	45	15
	Furnes	51	4	23	2	39	51
	Dunkirk	51	2	9	2	22	38
	Berg	50	57	43	2	26	41
	Gravelines	50	59	10	2	7	50
	Calais	50	57	32	1	51	16

VIII. Coasts of FRANCE, SPAIN, and PORTUGAL.

From Calais to Gibraltar.

	Calais	50	57	32	1	51	16
	Cape Grizness . . .	50	52	45	1	34	45
	Ambleteuse . . .	50	48	13	1	36	16
	Boulogne	50	43	37	1	36	59
	Etaples	50	30	44	1	38	46
	Montreul	50	27	42	1	46	2
	Rue	50	16	19	1	40	16
	Le Crotoy	50	12	52	1	37	39
	Abbeville	50	7	4	1	49	58
	S. Valery sur Somme	50	11	21	1	37	51
	Eu	50	2	52	1	15	33
	Dieppe Light . . .	49	55	34	1	4	44
	Ailly Light	49	55	17	0	57	14
	St. Valery en Caux .	49	52	12	0	41	40
	Fecamp	49	45	24	0	23	3
North Coast of France.	Cape de Caux . . .	49	41	0	0	11	15
	Cape de la Heve Lt.	49	30	42	0	4	15
	Havre	49	29	14	0	6	38
	Harfleur	49	30	23	0	11	57
	Honfleur	49	25	13	0	14	14
	PARIS, Observatory	48	50	15	2	20	15
	Rouen	49	26	27	1	5	50
					West		
	Caen	49	11	12	0	21	38
	Bayeux	49	16	34	0	41	56
	Carentan	49	18	17	1	14	50
	St. Marcou Island .	49	29	52	1	8	41
	Cape Barfleur Light	49	41	45	1	16	15
	Cherbourg . . .	49	38	31	1	37	3
	Pelee Isle	49	40	22	1	34	43
	Cape la Hague . .	49	43	33	1	56	15
	Alderney I., N.E end	49	44	5	2	8	58
	— S. W. end . . .	49	42	41	2	13	40
	Caskets Lights . .	49	43	50	2	22	0
	Guernsey I., St. Peter	49	28	15	2	33	18
	— St. Martin's Point	49	26	25	2	32	35
	— Pleinmont Point .	49	26	35	2	41	26
	— Doyle Fort . . .	49	31	20	2	31	25
	Herm I , N Point .	49	30	0	2	28	0
	Sercq, or Sark I., N. end	19	28	0	2	23	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(15) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
North Coast of France.	Sercq, or Sark I., S. end	49	25	25	2	23	28
	Jersey Island,						
	— C. Grosness	49	16	25	2	15	42
	— St. Aubin	49	12	15	2	11	0
	— St. Heliers	49	12	0	2	6	50
	— S. E. Point, Tower	49	10	57	2	2	36
	— N.E. Pt., LaCoupe	49	15	6	2	2	20
	Chausey Island	48	52	28	1	50	20
	St. Germain	49	13	15	1	35	15
	Coutances	49	2	54	1	26	23
	Granville	48	50	16	1	36	0
	Avranche	48	41	23	1	21	32
	Mount St. Michael	48	38	11	1	30	57
	Pontorson	48	33	18	1	31	17
	Cancalle	48	40	40	1	51	15
	St. Malo	48	39	3	2	1	11
	La Conchée	48	41	4	2	2	33
	Dinant	48	27	6	2	1	50
	Cape Frehel Light	48	41	10	2	18	36
	St. Brieu	48	31	2	2	43	55
	Brehat Island	48	50	5	2	55	33
	Tregueir	48	46	54	3	13	34
	Morlaix	48	34	50	3	53	21
	St. Pol de Leon	48	40	55	3	59	51
	Blanche Rock	49	1	25	3	57	45
	Isle de Bas	48	46	15	4	1	45
	St. Anthony's Point	48	40	10	4	28	45
	USHANT LIGHT	48	28	8	5	3	6
	Var. 25° 30′ *W.*						
Western Coast of France.	BREST	48	23	14	4	28	45
	St. Matthew's Light	48	19	34	4	45	39
	Point Ras	48	0	45	4	47	21
	Saints Rocks	48	5	5	5	4	45
	Point L'Abbé	47	48	40	4	11	45
	Quimper	47	58	29	4	5	45
	Glenan Islands	47	44	30	4	0	5
	Quimperlay	47	51	53	3	33	30
	L'ORIENT	47	45	11	3	21	2
	Var. 25° 27′ *W.*						
	Hennebon	47	48	1	3	17	7
	PORT LOUIS	47	42	47	3	20	59
	Isle of Groais	47	38	4	3	26	8
	QUIBERON, S. Pt.	47	26	30	3	3	45
	Belle I., N. end	47	23	0	3	13	45
	— S. end	47	17	17	3	4	45
	Houat Island	47	23	32	2	56	27
	Hedic Island	47	20	46	2	52	16
	Aurai	47	40	4	2	49	22
	Vannes	47	39	26	2	45	4
	Guizande	47	19	39	2	26	6
	Croisic	47	17	43	2	30	15
	Paimbeuf	47	17	15	2	0	51
	NANTES	47	13	6	1	32	44
	Bourneuf	47	2	28	1	51	9
	Le Pilier	47	2	32	2	21	5
	Noirmoutier I., S. Pt.	47	0	5	2	14	7
	Bouin Island	46	58	30	2	0	12
	Isle D'Yeu, W. Point	46	42	26	2	19	35
	St. Gilles	46	40	0	1	51	15
	Sables d'Olonne	46	29	52	1	46	50
	Var. 25° 49′ *W.*						

	(16) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Roches Bonnes	46	16	0	2	20	45
	I. of Rhe Light	46	14	49	1	33	25
	— St. Martin	46	12	18	1	21	52
	ROCHELLE	46	9	21	1	9	40
	ROCHEFORT	45	56	10	0	57	31
	Oleron Island, Tower	46	2	51	1	24	12
	Aix Island	46	1	38	1	10	41
	Cordouan Light	45	35	15	1	10	13
	Bordeaux	44	50	14	0	33	59
	Cape Feret	44	41	0	1	15	15
	BAYONNE	43	29	15	1	28	26
North and West Coasts of Spain.	St. Jean de Luz	43	22	30	1	40	55
	Fuentarabia	43	21	36	1	47	15
	Port Passages, ent. to	43	20	10	1	54	30
	St. Sebastian	43	19	30	1	58	30
	Cape Machichaco	43	28	10	2	39	48
	BILBAO	43	14	30	2	43	45
	Portugalete	43	20	10	2	58	20
	Santona	43	26	50	3	19	20
	Santander	43	28	20	3	39	50
	Cape Hoyambre	43	25	10	4	12	15
	Cape Prieto	43	28	30	4	44	45
	Cape de Mar	43	29	40	4	51	35
	Cape Lastres	43	34	0	5	13	55
	Gijon	43	35	19	5	36	15
	Cape Penas	43	42	16	5	46	33
	Cape Busto	43	36	0	6	24	0
	Ribadeo, entrance	43	34	45	6	59	30
	Cape Burela	43	41	30	7	17	0
	Port Vivero, entr.	43	43	45	7	32	30
	Port de la Estaca	43	47	50	7	38	50
	CAPE ORTEGAL	43	46	40	7	50	30
	Cape Prior	43	34	15	8	15	45
	Ferrol, entrance to	43	28	0	8	16	15
	Corunna Light	43	23	36	8	19	35
	Cisargas Isles	43	22	15	8	47	30
	Cape Villano	43	11	20	9	10	20
	Cape Toriana	43	3	0	9	17	0
	CAPE FINISTERRE	42	56	10	9	16	15
	Cape Corrobedo	42	33	30	9	1	35
	Ons Island, N. pt.	42	24	30	8	51	0
	VIGO	42	13	20	8	39	45
	R. Mino, entrance	41	52	30	8	47	0
Coast of Portugal.	Caminha	41	52	42	8	44	30
	Vianna Castle	41	42	30	8	43	10
	Villa de Conde	41	21	20	8	35	42
	OPORTO, entrance to	41	8	45	8	38	0
	Aveiro, entrance to	40	38	30	8	43	0
	Coimbra Observatory	40	12	30	8	24	25
	Cape Mindego	40	11	50	8	54	0
	Figueira	40	10	0	8	51	0
	Farilhao	39	29	18	9	33	0
	Burlings Island	39	24	40	9	30	42
	Cape Carboeiro Light	39	21	50	9	21	30
	Lisbon Rock Light	38	46	30	9	30	36
	LISBON Observatory	38	42	38	9	8	15
	Cape Espichel Light	38	24	54	9	13	8
	Setubal or St. Ubes Lt.	38	28	54	8	56	30
	Cape Sines	37	57	30	8	52	42
	Odemira, Bar of	37	39	0	8	49	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(17) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Cape St. Vincent .	37	2	54	9	0	54
	Var. 23° *W.*						
	Lagos	37	8	0	8	38	3
	Cape Carvoeiro . .	37	7	0	8	22	30
	Cape Santa Maria .	36	55	24	7	49	50
	R. Guadiana, entr. .	37	9	30	7	20	0
Spain.	St. Lucar, entrance to	36	44	18	6	24	15
	Cadiz, Observatory .	36	32	0	6	17	37
	St. Sebastian's Light	36	31	10	6	18	50
	Cape Trafalgar . .	36	10	15	6	1	52
	Tarifa Island Light .	36	0	50	5	36	15
	Gibraltar,						
	— Europa Point . .	36	6	20	5	20	53

IX. The North Side of the MEDITERRANEAN.

	Gibraltar,						
	— Europa Point . .	36	6	20	5	20	53
	Callera Tower . . .	36	18	25	5	15	2
	Estapona	36	25	10	5	8	52
	Cape Morat . . .	36	31	0	4	37	55
	Malaga Light . . .	36	43	22	4	25	2
	Salobrina	36	45	0	3	40	10
	Corchuna Castle . .	36	41	30	3	26	34
	Adra Fort	36	44	36	3	1	42
	Guardias Viejas Cast.	36	41	30	2	52	52
	Almeria	36	51	29	2	32	0
	Cape de Gatt,						
	— Coralletes Tower	36	44	0	2	14	22
	Moxacar Tower . .	37	6	20	1	54	27
	Cope Tower . . .	37	25	5	1	33	27
South and East Coasts of Spain.	Cape Tinosa . .	37	31	10	1	10	22
	Carthagena, Obs. .	37	35	50	1	0	37
	Escombrera I. . . .	37	33	30	0	59	52
	Cape Palos . . .	37	37	15	0	42	22
	Cape Cervera,						
	— Torre Vieja . .	37	58	55	0	41	27
	Cape Santa Pola . .	38	12	5	0	31	42
	Alicante	38	20	41	0	29	57
	Benidorme Tower .	38	32	10	0	4	42
						East	
	Cape Nao	38	44	40	0	10	8
	Cape St. Martin . .	38	47	0	0	9	30
	C. St. Antonio Tower	38	49	50	0	8	8
						West	
	C. Cullera Tower .	39	9	0	0	11	17
	Valencia, City . .	39	26	40	0	23	2
	C. de Canet Tower .	39	40	0	0	10	52
						East	
	C. Oropeza Tower .	40	5	33	0	6	58
	Columbreta Islet . .	39	56	0	0	42	58
	Pensicola Point . .	40	22	40	0	28	8
	Port Alfaque,						
	— Canal Tower . .	40	37	25	0	37	38
	Cape Tortosa,						
	— Buda Island . .	40	43	25	0	55	28
	Cape Salou	41	4	45	1	10	35
	Terragona	41	8	50	1	18	23

	(18) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Cape Gros Tower .	41	9	40	1	27	3
	Barcelona, Mole .	41	22	51	2	10	38
	Mataro	41	33	0	2	25	30
	Cape Tosa	41	42	50	2	53	58
	Palamos, Pt. Grosa	41	51	10	3	3	38
	Cape St. Sebastian .	41	53	30	3	8	8
	Medas Isles, S. end	42	3	10	3	9	23
	Cape Norfeo . . .	42	14	52	3	12	38
	Cape de Creux . .	42	19	45	3	15	48
	Cape Servera . . .	42	27	15	3	9	0
	Port Vendre . . .	42	32	5	3	5	57
	Elne . . . . . ,	42	35	44	2	58	23
	Perpignan	42	41	58	2	54	50
	Fort Leucate . . .	42	55	30	3	5	10
	Narbonne	43	10	50	3	0	55
	Fort Brescou . . .	43	15	20	3	30	35
	Agde	43	18	40	3	28	15
	Cette Light . . .	43	23	37	3	41	11
	Montpellier, Obs. . .	43	36	16	3	52	46
	Aiguemortes Light .	43	34	2	4	7	31
	St. Marie	43	26	42	4	24	0
	Mouth of the Rhone,						
	— St. Louis Tower .	43	22	10	4	47	50
	Foz	43	26	0	4	54	40
South Coast of France.	C. Couronne . . .	43	18	50	5	1	55
	Marseilles, Obs. . .	43	17	50	5	22	15
	Planier Island Light	43	11	50	5	13	30
	Cape Roux	43	13	0	5	20	0
	Cassis Mole . . .	43	12	20	5	33	0
	Bandol Castle . . .	43	8	20	5	45	30
	Cape Sicie	43	3	6	5	50	15
	Toulon	43	7	10	5	55	40
	Giens Castle . . .	43	2	9	6	7	26
	Hyeres Islands,						
	— Porquerolles,						
	Fort Langoustier .	42	59	52	6	12	9
	— Portcross,						
	— Gabiniere Rock .	42	59	6	6	22	40
	— Titan, E. point .	43	2	28	6	30	5
	Cape Taillat . . .	43	7	45	6	39	10
	St. Tropez	43	15	20	6	40	10
	Frejus	43	26	15	6	44	20
	Cannes	43	33	20	7	0	15
	Lerin Is., Ft. Montery	43	31	40	7	2	0
	Cape Garoupe . . .	43	33	0	7	7	80
	Antibes	43	34	40	7	7	50
	River Var, entr. . .	43	39	50	7	10	10
	Nice	43	41	20	7	16	49
Northern Coast of Italy.	Villa Franca Light .	43	40	18	7	19	37
	Monaco	43	40	40	7	26	18
	Cape St. Martin . .	43	43	30	7	32	20
	Ventimiglia Point .	43	44	20	7	42	36
	Cape St. Remo . .	43	47	30	7	49	53
	Cape del Armi . .	43	49	30	7	53	58
	Port Maurizio, Mole	43	54	49	7	59	36
	Cape Oneglia . . .	43	56	10	8	3	0
	C. de la Melle . . .	43	58	10	8	11	5
	Gallinara Island . .	44	2	15	8	13	20
	Finale Church . . .	44	10	50	8	19	15
	Cape Noli	44	11	0	8	23	20

TABLE LVI.

LATITUDES AND LONGITUDES.

	(19) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
Northern Coast of Italy.	Cape Vado	44	15	0	8	25	20
	Savona, Mole	44	18	0	8	28	0
	Polla Rock	44	25	20	8	46	12
	Genoa Light	44	24	22	8	53	5
	Nervi	44	23	40	9	2	25
	Cape Porto Fino	44	18	27	9	14	30
	Sestri Levante	44	16	40	9	25	40
	Cape dell Mesco	44	8	20	9	39	40
	Port Venere	44	3	30	9	51	30
	Spezzia, Lazaretto	44	4	10	9	52	26
	Tino Island	44	2	0	9	52	30
	——						
West Coast of Italy.	Lavenza Tower	44	1	20	10	4	20
	Motrona Tower	43	54	30	10	13	0
	Pisa, Observatory	43	43	20	10	24	16
	FLORENCE	43	46	41	11	15	45
	Viareggia, Mole	43	51	35	10	15	0
	Malora Shoal, Tower	43	33	0	10	12	45
	Leghorn Light	43	32	20	10	17	30
	Vado Tower	43	21	35	10	27	0
	Mal de Vetro Shoal	43	20	0	10	21	40
	Castagnelto Tower	43	10	50	10	32	20
	Piombino, Mole	42	55	15	10	32	20
	Fullonica, Mole	42	55	6	10	47	0
	Cape Troya Tower	42	47	29	10	45	45
	Castiglione Tower	42	44	55	10	55	15
	R. Ombrone, entr.	42	37	32	11	2	30
	East Formiche	42	37	0	10	53	0
	Talamone	42	32	10	11	10	30
	San Stefano	42	25	35	11	9	45
	Mount Argentaro	42	21	45	11	12	15
	Civita Vecchia Light	42	4	38	11	44	52
	Cape Linaro	42	1	0	11	49	50
	River Tiber,						
	— Fiumicino Light	41	45	48	12	11	30
	ROME, St. Peters'	41	54	0	12	26	55
	Ardea	41	37	0	12	33	0
	Port Anzo, Mole	41	26	30	12	42	10
	C. Monte Circello	41	11	50	13	5	0
	——						
Coast of Naples.	Terracina	41	16	0	13	15	0
	Gaeta, Mole	41	12	20	13	35	30
	Cape Miseno	40	46	20	14	4	55
	Pozzuoli	40	49	0	14	6	35
	NAPLES Light	40	50	12	14	15	45
	Mount Vesuvius	40	48	40	14	26	40
	Castelamare	40	40	50	14	29	0
	Cape Campanella	40	33	15	14	19	50
	Salerno	40	40	0	14	45	20
	Cape Licosa Tower	40	13	50	14	53	0
	Policastro	40	2	0	15	33	0
	Cetrari	39	29	45	15	56	30
	Mount Cocuzza	39	16	0	16	6	0
	Cape Suvero Tower	39	2	55	16	8	40
	St. Euphemia	39	3	0	16	15	0
	Cape Vaticano	38	36	30	15	52	0
	Gioja	38	25	0	15	56	0
	Scylla Castle	38	14	15	15	44	0
	Reggio	38	5	45	15	39	0
	Cape dell Armi Tower	37	57	30	15	41	35
	Cape Spartivento	37	55	45	16	3	15
	——						

	(20) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
South Coast of Italy.	Cape Stilo	38	28	20	16	35	0
	Squillace	38	48	30	16	28	0
	Cape Rizuzto	38	57	0	17	0	30
	Cape Naa	39	5	30	17	13	45
	Cotrona Mole	39	7	20	17	10	0
	Strongoli	39	17	0	17	5	0
	Point Alice	39	24	15	17	10	0
	Pt. del Tronta Tower	39	35	0	16	47	10
	Roseto	39	59	0	16	34	0
	Tarento,						
	— St. Pietro Island	40	26	10	17	9	0
	Gallipoli,						
	— St. Andrea Island	40	2	0	17	56	30
	C. St. Maria, Convent	39	48	40	18	23	0
	——						
Adriatic Sea or Gulf of Venice.	Cape Otranto Tower	40	7	46	18	30	25
	St. Andrea Tower	40	15	30	18	26	30
	Brindisi Fort	40	39	27	18	1	20
	Torre della Testa	40	41	0	17	54	45
	Monopoli	40	57	19	17	20	30
	Polignano	40	59	50	17	15	0
	Mola	41	4	10	17	7	45
	Bari, Mole	41	8	30	16	54	15
	Malfetto, Mole	41	13	10	16	38	0
	Trani	41	17	30	16	27	25
	Barletta Light	41	20	25	16	19	0
	Torre di Rivoli	41	29	13	15	57	5
	Manfredonia, Mole	41	37	38	15	56	14
	Viesti, Croce Island	41	52	35	16	11	30
	Perchichi	41	56	42	16	1	10
	Varano Towers	41	55	23	15	48	50
	Mileto Tower	41	55	56	15	38	42
	Campo Marino	41	57	49	15	2	25
	Termoli	42	0	25	15	0	26
	Petacchiato	42	1	3	14	52	13
	Vasto	42	6	30	14	43	8
	Point Penna	42	10	20	14	44	0
	Ortona, Mole	42	20	30	14	26	30
	Francavilla	42	24	5	14	19	0
	Castelamare	42	28	0	14	12	24
	Silvi	42	33	14	14	6	48
	Mt. Pegnano, Church	42	40	32	14	1	0
	Colonella	42	52	20	13	53	5
	Rio Tronto, Tower	42	53	45	13	55	40
	Grottamare	42	59	49	13	52	50
	Pedaso	43	5	59	13	51	1
	Fermo	43	9	35	13	44	0
	Cittanova	43	19	0	13	44	30
	Loretto, Steeple	43	26	36	13	37	0
	Ancona, Light	43	37	42	13	30	26
	Sinigalia Light	43	43	2	13	13	11
	Fano Light	43	51	0	13	1	10
	Pesaro Light	43	55	42	12	54	39
	Rimini Light	44	4	35	12	34	10
	Cervia Tower	44	16	0	12	21	7
	Ravenna Tower	44	25	25	12	12	11
	Goro	44	50	31	12	19	30
	Point del Maestra	44	58	45	12	31	40
	Port Brondolo, Fort	45	10	10	12	19	25
	Chioggia	45	13	26	12	17	55
	Palestrina Church	45	15	40	12	19	15

TABLE LVI.

LATITUDES AND LONGITUDES

	(21) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Port Malamoco, — Fort Alberoni	45	20	50	12	20	30
	VENICE, St. Mark's Tower	45	25	53	12	20	31
	Caorle	45	35	45	12	53	31
	R. Tagliamento, entr.	45	38	40	13	3	45
	Port Lignano	45	40	56	13	7	32
	Grado	45	40	18	13	23	10
	Trieste Castle	45	38	37	13	46	27
	Cape d' Istria	45	32	17	13	43	58
	Pirano, Steeple	45	30	30	13	34	20
	Point Salvore Light	45	29	45	13	30	25
	Cittanova	45	18	51	13	33	35
	Parenzo	45	13	37	13	35	40
	Rovigno	45	4	56	13	37	57
	Pola, St. Francis Ch.	44	52	16	13	50	39
	Cape Promontore	44	46	0	13	55	10
Adriatic Sea or Gulf of Venice.	Albona Steeple	45	4	56	14	7	30
	Fianona	45	7	50	14	10	30
	Fiume, Clock	45	19	30	14	26	30
	Porto Re	45	15	50	14	33	35
	Segna, Mole	44	59	40	14	53	40
	Karlopago, Mole	44	31	40	15	4	30
	Nona	44	14	36	15	10	34
	Zara, St. Simons Ch.	44	6	50	15	12	58
	Zara Vecchia	43	56	19	15	26	33
	Sabenico	43	44	15	15	53	28
	Trau, Steeple	43	30	55	16	15	10
	Spalatro, Paulini To.	43	30	25	16	26	20
	Mount Borak	43	25	53	16	43	58
	Marcaska	43	17	32	17	1	5
	Ragusa, Mole	42	38	10	18	6	46
	Markana I., Tower	42	34	15	18	11	10
	Melonta	42	27	7	18	25	0
	Kattaro, — Point Ostro	42	23	20	18	31	16
	Budua, Greek Steeple	42	16	33	18	50	27
	Antivari, Point Ledo	42	2	25	19	6	25
	Dulcigno, Mole	41	53	45	19	11	40
	Cape Rodoni	41	37	40	19	28	10
	Cape Pali	41	23	0	19	24	30
	Durazzo Mole	41	17	32	19	27	46
	Cape Laghi	41	10	10	19	26	0
	Aulona or Valona, — Custom House	40	27	15	19	26	20
	Saseno Island, S. Pt.	40	30	20	19	14	10
	Cape Linguetta	40	25	20	19	14	40
	——						
	Port Palermo	40	2	58	19	48	10
	Cape Kiephali	39	55	40	19	53	30
	Parga, Town	39	16	30	20	23	25
	Kastrosikia	39	6	0	20	38	35
Albania.	Previsa, — Fort Pantokratera	38	56	10	20	44	0
	Dragomestre	38	32	45	21	6	0
	Skropha Cove	38	18	55	21	8	50
	Oxia Island, S. end	38	17	20	21	6	15
	Messalongia Fort	38	20	30	21	24	20
	Point Bakari	38	17	15	21	30	40
	Roumelia Castle	38	19	15	21	48	30
	Lepanto	38	21	45	21	51	0
	——						

	(22) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Corinth	37	53	37	22	52	5
	Morea Castle	38	18	20	21	49	30
	Patrass, Mole	38	14	25	21	46	20
	Cape Papas	38	12	40	21	25	30
	Konopoli Rock	38	5	30	21	22	15
	Tornisi Castle	37	53	45	21	9	30
	Cape Catakolo	37	38	12	21	20	0
	Arcadia Town	37	14	15	21	41	50
	Cape Konello	37	12	0	21	36	30
	Prodano Island, Peak	37	1	50	21	34	10
	Navarino Castle	36	52	30	21	41	0
	Modon Light	36	48	5	21	41	8
	Sapienza Island, S.Pt.	36	42	30	21	41	0
Morea.	Cabrera, S. E. Point	36	40	0	21	47	30
	Cape Gallo	36	41	20	21	54	56
	Venetico Island, mid.	36	40	10	21	55	15
	Coron or Koron	36	47	26	22	0	0
	Kalomata	36	59	45	22	8	25
	Cape Kephali	36	53	0	22	9	0
	Port Djimovo	36	39	0	22	23	6
	CapeGrosso, S.W. Pt.	36	28	0	22	21	0
	Cape Matapan	36	21	30	22	28	0
	Port Pagagna, N. Pt.	36	38	0	22	30	30
	Eurotas River, entr., — Vasili Castle	36	48	0	22	35	0
	Rupina Tower	36	40	30	22	48	15
	Cape St. Angelo	36	26	0	23	12	30
	Napoli di Malvasia, — Fort	36	44	0	23	2	0
	Nauplia or Napoli di Romania	37	33	50	22	47	30
	——						
	Athens, — Philopapus	37	57	45	23	43	30
	Cape Colonna	37	39	15	24	1	34
Eastern Coast of Greece.	Cape Marathon	38	10	20	21	4	45
	Negropont	38	33	36	23	42	0
	Cape Doro	38	9	30	24	36	0
	Cape Kili	38	39	30	24	10	0
	Mount Delphi	38	37	43	23	51	18
	Mount Pelion	39	26	17	23	2	55
	Mount Olympus	40	4	32	22	21	53
	Salonica, Mill	40	38	47	22	57	13
	Cape Drepano	39	56	53	23	57	17
	Mount Athos	40	9	29	21	19	53
	Cape Maori	40	51	0	25	45	0
	Cape Paxi	40	36	0	26	5	0
	Cape Stilia	40	19	0	26	13	0
	Entr. to Dardanelles, — Europa Castle	40	2	25	26	12	15
	Gallipoli Light	40	24	30	26	39	45
	——						
	Rodosto	40	59	34	27	30	0
Sea of Murmara.	Heraclia	40	59	3	27	57	0
	Point Stephano	40	57	0	28	50	0
	CONSTANTINOPLE, — Mosqueof St.Soph.	41	0	12	28	59	2
	Scutari, — Leander's Tower	41	1	0	29	0	30
	Princes Isles, westm.	40	52	0	28	59	0
	Nicomedia	40	45	0	30	0	0

TABLE LVI.

LATITUDES AND LONGITUDES.

(23) Places.	Lat. N.			Lon. E.		
	°	′	″	°	′	″
Cape Karabouga . .	40	28	0	27	16	0
Marmara I., S.W. end	40	37	4	27	30	50
— East end, Light .	40	38	0	27	46	0

X. The BLACK SEA and SEA of AZOF.

	Places	°	′	″	°	′	″
	Bosphorus,						
	— European Light .	41	14	10	29	7	0
	Cape Kouri . . .	41	52	43	28	2	57
	Bourgas, City . . .	42	29	20	27	27	57
	— St. John's I. . .	42	25	54	27	41	22
	Cape Emeneh . . .	42	41	40	27	53	30
	VARNA, S. E. bastion	43	12	15	27	56	10
Black Sea.	Cape Calaghriah . .	43	21	25	28	27	5
	Mouths of the Danube						
	— Ghedrilch, entr.	44	52	45	29	36	25
	— Soulineh, Tower .	45	10	15	29	40	50
	Serpent's Island . .	45	15	0	30	10	55
	Ackerman	46	12	0	30	24	0
	C. Fontan, Light . .	46	23	20	30	44	0
	ODESSA, Lazaretto .	46	28	54	30	43	22
	Berezan I., Fort . .	46	35	34	31	22	42
	Otchakof	46	36	25	31	31	50
	Nicolaef, Obs. . . .	46	58	55	32	0	37
	Kherson	46	37	46	32	38	33
	Tendra I., Light . .	46	19	0	31	29	20
	Perecop	46	8	57	33	42	9
	Cape Tarkan, Light .	45	21	35	32	31	15
	Koslof, Fort . . .	45	9	0	33	18	15
Crimea.	Cape Kherson, Light	44	34	25	33	20	45
	Sevastopol, Steeple .	44	35	25	33	31	30
	C. Saritche . . .	44	22	0	33	44	15
	Alouchti	44	41	0	34	25	55
	Caffa	45	1	37	35	23	28
	Cape Karak . . .	45	2	25	36	18	0
Sea of Azof.	Kertch	45	21	29	36	28	49
	Jenikaleh	45	21	12	36	36	11
	Taman	45	14	40	36	43	45
	Arabat	45	21	0	35	31	0
	Marionpol	47	6	0	37	37	0
	Taganrok, Fort . .	47	12	40	38	59	0
	AZOF	47	9	0	39	25	0
	Sougoudjak . . .	44	39	0	37	46	35
	Ghelenjik	44	30	30	38	7	0
	Soukourn Kaleh . .	42	59	20	41	0	8
	Poti or Phaz,						
	— New Fort . . .	42	7	30	41	39	55
Black Sea.	C. Batoum, Tower .	41	40	0	41	35	25
	Rizeh	41	2	25	40	30	10
	Trebizonde	41	2	0	39	41	52
	Tiriboli	41	1	0	38	49	10
	Keresoun	40	57	10	38	23	40
	Cape Vona	41	7	5	37	48	40
	Eunieh	41	9	0	37	18	0
	R. Kizel Ermak, entr.	41	45	0	35	56	0
	SINOPE	42	2	30	35	9	45
	Cape Indjeh . . .	42	7	57	34	56	25

(24) Places.	Lat. N.			Lon. E.		
	°	′	″	°	′	″
Cape Kerempeh . .	42	2	1	33	19	5
Amasserah	41	45	27	32	21	15
Cape Kilimoli . . .	41	32	0	31	51	0
Heraclea	41	16	8	31	24	47
Cape Kerpeli . . .	41	14	0	30	15	0
Bosphorus, Asia Light	41	13	0	29	9	0

XI. East and South Coasts of the MEDITERRANEAN.

	Places	°	′	″	°	′	″
	Cape Janissary . .	39	59	30	26	12	30
	Troy, Ruins of . .	39	52	0	26	11	0
	Mount Ida	39	45	45	26	42	0
	Cape Baba	39	30	0	26	4	30
	Adramytti	39	34	50	26	57	0
	SMYRNA	38	25	36	27	6	45
	Cape Karabouroun .	38	41	30	26	21	0
	Cape Blanco . . .	38	17	0	26	11	0
	Cape Koraka . . .	38	6	0	26	34	20
	Sighajik, Island . .	38	11	54	26	44	53
	Var. 12° 45′ *W.*						
	Scalanuova,						
Anatolia.	— Koosh Adassi I. .	37	50	30	27	15	0
	Cape St. Mary . .	37	39	0	27	2	0
	Boudroun, Tower . .	37	1	21	27	25	18
	Cape Crio	36	40	46	27	21	6
	Cape Marmorice . .	36	41	0	28	18	0
	Karagatch,						
	— Linaro Island . .	36	43	0	28	26	0
	Gulf of Makri,						
	— Cape Iria . . .	36	32	40	29	2	0
	Seven Capes, S. Pt. .	36	18	0	29	15	0
	Patara	36	14	30	29	20	50
	Cape Khilidonia . .	36	12	0	30	26	6
	Cape Avova . . .	36	35	8	30	38	25
	Adalia	36	52	10	30	45	0
Karamania.	Cape Karaboornoo .	36	38	0	31	43	10
	Cape Anamour . .	36	0	50	32	50	58
	Cape Cavaliere . .	36	7	50	33	42	35
	P. Lissan el Kabeh .	36	13	45	33	59	10
	Karadash boornoo .	36	32	40	35	21	26
	Ayas	36	46	10	35	48	0
	Scanderoon or						
	Alexandretta . . .	36	35	27	36	15	0
	Cape Khynzyr . .	36	19	0	35	49	30
	ANTIOCH	36	11	0	36	9	30
	Cape Possidi . . .	35	52	10	35	50	55
Syria.	Latakia	35	30	30	35	47	55
	Tortosa	34	50	25	35	51	50
	Tripoli	34	26	22	35	51	32
	Cape Bairout . . .	33	49	45	35	28	0
	Seydi or Sidon . .	33	34	5	35	23	50
	Tsour or Tyre . . .	33	17	0	35	14	35
	Acre	32	54	35	35	6	20
	Jaffa	32	3	25	34	46	10
	JERUSALEM . .	31	47	47	35	20	15
	Ascalon, Ruins . .	31	39	0	34	32	55

TABLE LVI.

LATITUDES AND LONGITUDES.

	(25) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	El Arish, Fort . . .	31	5	30	33	48	25
	Damietta	31	25	43	31	49	30
	CAIRO	30	3	20	31	18	15
	Rosetta	31	25	0	30	28	20
Egypt.	Aboukir, Tower . .	31	20	35	30	6	0
	ALEXANDRIA, Light .	31	12	35	29	53	27
	— Point Eunostos .	31	11	31	29	51	28
	Var. 10° 55′ *W.*						
	Arabs Tower . . .	30	58	15	29	34	20
	Ras al Kanais . .	31	15	32	27	52	25
	Ishailoo Rocks. . .	31	31	17	26	39	44
	——						
	Tifarh Rocks . .	31	36	0	26	16	0
	Salloume	31	28	35	25	10	0
	Cape Luko or						
	Ras al Milhr . . .	31	54	0	25	3	0
	Toubrouk	32	3	51	24	3	33
	Bomba, Tank Point .	32	23	30	23	11	20
	— Bhurda Island .	32	22	36	23	16	23
	Var. 14° 55′ *W.*						
	Cape Razatin . . .	32	34	0	23	13	10
	Derna	32	45	59	22	40	45
	Cyrene, Theatre . .	32	49	38	21	48	30
	Cape Razat . . .	32	55	56	21	38	54
	Pt. Tolometa, Old T.	32	42	29	20	54	50
	Teukera	32	32	20	20	33	44
	Bengasi, Castle . .	32	6	50	20	2	56
	Karkora, Rock . .	31	28	20	20	0	10
	Sahan	31	2	44	20	12	0
	Gharra Island . . .	30	47	20	19	57	24
	Marsa Braiga . . .	30	23	29	19	39	30
Tripoli.	Sookren	30	16	0	19	18	10
	Bushaifa Island . .	30	17	40	19	11	30
	Linoofe	30	23	51	18	43	56
	Kudia	30	44	13	18	17	50
	Boosaida	30	59	30	17	39	21
	Shaiwsha	31	9	30	17	10	0
	Zaphran	31	12	30	16	41	29
	Djerid	31	23	41	15	52	10
	Isa, Ruins	31	32	50	15	31	46
	Pt. Kharra, Date Tree	32	10	0	15	24	48
	Cape Mesurata,						
	— Bushaifa Marabut	32	21	26	15	16	35
	— North Extreme .	32	25	25	15	10	0
	Ziliten	32	29	51	14	33	48
	Lebida	32	39	43	14	14	0
	Ras al Hamra . . .	32	47	15	13	53	0
	Tajoura Point . . .	32	54	56	13	21	0
	TRIPOLI, Castle . .	32	53	56	13	10	58
	Var. 16° 35′ *W.*						
	Old Tripoli, Fort . .	32	48	51	12	25	29
	Zoara	33	55	10	12	3	55
	Jerba I., Zug Castle .	33	53	0	10	53	20
	——						
	Kabes	33	52	40	10	4	15
	Karkenna Islands,						
	— Kusha Island . .	34	49	0	11	18	40
Tunis.	Cape Burdj. Kadija .	35	9	30	11	10	0
	Mehedia, Ruins . .	35	31	15	11	7	15
	Al Kuriat Is., N. end	35	48	0	11	4	0
	Monasteer	35	44	30	10	51	30
	Soussa, Mole . . .	35	47	50	10	39	0

	(26) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Herklah	35	59	10	10	30	0
	Hammamet . . .	36	23	0	10	38	30
	Kalibia	36	49	30	11	8	30
	Cape Bon, N. Pt. .	37	6	0	11	2	25
	Zembra Island mid. .	37	8	30	10	48	30
	Cape Zaphran . . .	36	52	0	10	36	0
	Goletta, entr. . . .	36	48	0	10	16	30
	TUNIS, City . . .	36	46	40	10	6	15
Tunis.	Cape Carthage . .	36	52	10	10	19	45
	Pt. Farina	37	10	55	10	14	30
	Piana Island . . .	37	11	0	10	18	0
	Cane Rocks . . .	37	22	0	10	3	0
	Cape Zibeib . . .	37	16	30	10	0	30
	Bizerta, Mole . . .	37	16	30	9	49	20
	Cape Bianco . . .	37	20	0	9	48	0
	Cape Serrat . . .	37	13	30	9	9	30
	Galita Island . . .	37	30	50	8	54	0
	Sorelli Rocks . . .	37	25	0	8	37	0
	Cape Negro . . .	37	5	0	8	55	0
	Tabarca Island . .	36	56	25	8	42	30
	——						
	Cape Ross	36	55	0	8	12	50
	Cape Mavera . . .	36	58	0	7	50	0
	Bona, Town . . .	36	53	30	7	48	20
	Ras Shailouk . . .	37	2	30	7	33	5
	Ras Hadeed or						
	Cape Ferro	37	5	30	7	11	15
	Ras al Frigana . .	37	7	0	6	28	45
	Jijeli	36	50	30	5	47	0
	Cape Carbon . . .	36	47	0	5	9	40
	Pisan Rocks . . .	36	49	30	5	2	30
	C. Dellys or Tedilles	36	55	20	4	14	15
Algiers.	Cape Bingut . . .	36	55	15	3	54	15
	Cape Matafou . . .	36	48	30	3	14	0
	ALGIERS, Light . .	36	47	30	3	4	20
	Sidi Ferruch Bay .	36	45	0	2	51	0
	Zerzahal	36	37	0	2	12	0
	Cape Tennez . . .	36	33	0	1	22	0
	Palomas Island . .	36	26	0	0	56	9
	Cape Ivi	36	6	0	0	11	30
					West		
	Cape Ferrat . . .	35	55	0	0	23	0
	Oran, Castle . . .	35	43	27	0	38	0
	Cape Falcon . . .	35	47	0	0	48	0
	Habiba Island . . .	35	43	30	1	7	30
	Cape Figalo . . .	35	34	30	1	12	0
	Cape Noe . . .	35	11	0	1	43	0
	——						
	Zaphran Islands, mid.	35	12	0	2	26	0
	Melilla	35	18	15	2	58	0
	Cape Tres Forcas . .	35	27	55	2	57	40
	Al Buzema,						
Marocco.	— Garrison Rock . .	35	16	30	3	47	0
	Penon de Velez . .	35	11	0	4	15	0
	Pescadores	35	16	0	4	45	0
	Pt. Mazari or Tetuan	35	33	15	5	15	20
	Tetuan, Tower . .	35	37	0	5	18	30
	Cape Negro . . .	35	41	30	5	17	0
	Ceuta,						
	— Almina Pt. . .	35	54	4	5	17	0
	Tangier	35	47	0	5	49	30
	Cape Spartel . . .	35	47	15	5	54	25

TABLE LVI.

LATITUDES AND LONGITUDES.

XII. Islands in the MEDITERRANEAN, GULF OF VENICE, and ARCHIPELAGO.

	(27) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Alboran Isle . . .	35	57	0	3	0	40
	—						
The Balearic Islands.	Formentera,				East		
	— Point del Aguila .	38	40	30	1	26	58
	— La Mola or E. Pt.	38	42	10	1	35	23
	Iviza or Ivica,						
	— Point Denserra .	39	6	22	1	31	53
	— Cape Nono . . .	39	2	50	1	23	0
	— Bedra Island . .	38	51	0	1	17	0
	— Cape Falcon . .	38	50	40	1	24	20
	Cabrera Island,						
	— Point Anciola . .	39	7	15	2	58	0
	Majorca or Mallorca,						
	— Point Rebagada .	39	34	25	2	23	13
	— Cape Cala Figuera	39	25	30	2	33	0
	— Palma, Town . .	39	34	4	2	39	0
	— Cape Salinas . .	39	15	45	3	5	3
	— Cape de Pera . .	39	42	20	3	30	18
	— Cape Formenton .	39	57	15	3	17	58
	Minorca,						
	— Cape Dartuch . .	39	56	0	3	51	0
	— Cape Minorca . .	40	2	50	3	50	43
	— Cape Mola, Mahon	39	52	32	4	24	15
	— South E. Point .	39	47	0	4	21	22
	—						
Sardinia.	Cape del Testa or						
	Longo Sardo : . .	41	15	0	9	7	0
	Asinara I., N. E. end	41	8	5	8	18	18
	Cape Falconi . . .	40	59	13	8	10	30
	Cape Argentara . .	40	45	0	8	4	20
	Cape Caccia . . .	40	33	30	8	5	0
	Alghero, Church . .	40	32	50	8	15	35
	Cape Marargui . .	40	19	25	8	20	15
	Mal de Ventri Island	39	59	0	8	16	0
	Coscio di Donna Rock	39	52	25	8	14	0
	Cape St. Marco . .	39	50	50	8	24	0
	Cape Frasco . . .	39	45	40	8	25	0
	Oristano, Steeple . .	39	53	55	8	33	40
	Cape Pecora . . .	39	27	0	8	21	0
	St. Pietro Island,						
	— Carlo Fort . . .	39	9	0	8	17	0
	S. Antioco Island,						
	— Point Sperone . .	38	57	35	8	23	0
	Toro Rock	38	52	0	8	22	30
	Cape Teulada . . .	38	51	36	8	36	42
	Pula, Tower . . .	39	0	15	9	1	25
	CAGLIARI, Mole . .	39	12	10	9	6	36
	Cape Carbonara,						
	— Cavoli I., Tower	39	4	24	9	32	0
	Cape Bellavista . .	39	59	30	9	45	0
	Tavolara I., N. E. Pt.	40	54	36	9	44	0
	Montorio I., N.E. Pt.	41	4	42	9	36	5
	Madelaine I., N. Pt.	41	16	0	9	25	0
	—						
	Giraglia I., Tower .	43	1	42	9	23	53
	Cape Corso . . .	43	0	35	9	22	55

	(28) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
Corsica.	St. Fiorenzo . . .	42	41	3	9	17	42
	Calvi	42	34	7	8	45	16
	Cape Turghia, Tower	42	14	11	8	32	49
	Ajaccio	41	55	1	8	44	4
	Point Senetoso . .	41	34	30	8	46	30
	Bonifacio, Tower . .	41	23	11	9	9	16
	Porto Vecchio . .	41	35	29	9	16	36
	BASTIA, Church . .	42	41	36	9	26	45
	—						
Italian Islands.	Gorgona, Tower . .	43	25	25	9	53	40
	Capraja, N. Point,	43	4	30	9	50	0
	— South Point . .	43	0	10	9	49	0
	Elba, Cape Vita . .	42	52	12	10	25	10
	— Port Ferragio . .	42	48	40	10	19	30
	— Cape Infola . .	42	50	12	10	15	20
	— Cape Dorana . .	42	48	15	10	5	30
	— Cape Calamita .	42	42	2	10	24	28
	Pianosa, N. Point .	42	35	10	10	7	0
	Africa Rocks or						
	West Formiches . .	42	21	20	10	8	20
	Monte Christo, mid.	42	19	40	10	20	0
	East Formiches . .	42	37	0	10	53	0
	Giglio Island, N. Pt.	42	21	40	10	57	0
	— South Point . .	42	17	25	10	58	45
	Gianuti, mid. . . .	42	13	10	11	9	0
	Palmarola, N. Point	40	57	8	12	52	10
	Ponza, S. Point . .	40	52	39	12	57	35
	Botte Rock . . .	40	50	20	13	6	10
	Zannoni, mid. . . .	40	57	40	13	3	30
	Vandotina, N. end .	40	47	30	13	25	40
	Ischia, Castle . . .	40	43	50	13	57	5
	— Point Imperator .	40	42	0	13	49	45
	Procida, N. E. Point	40	46	0	14	1	25
	Capri, Point Carena .	40	30	45	14	11	40
	—						
Sicily.	Faro, Light . . .	38	15	50	15	40	40
	MESSINA, Light . .	38	11	30	15	34	40
	Var. 18° 33′ W.						
	Scaletta, Fort . . .	38	1	45	15	27	45
	Taormina	37	48	15	15	17	40
	Mount Etna, peak .	37	43	31	15	0	0
	Aci Reale, Pt. Tocco	37	34	20	15	11	30
	Catania, Mole . . .	37	28	20	15	5	15
	Augusta, Light . .	37	12	50	15	13	15
	Syracuse, Light . .	37	2	58	15	16	50
	Passaro Island, Tower	36	41	30	15	8	56
	Cape Passaro . . .	36	40	0	15	7	30
	Cape Scalambra Tower	36	46	13	14	30	15
	Scoglietti	36	52	34	14	27	25
	Terranova	37	2	54	14	15	0
	Alicata, Castle . .	37	4	3	13	55	54
	Palma	37	8	47	13	43	11
	Girgenti, Mole . .	37	15	39	13	31	40
	Cape Bianco . . .	37	22	25	13	16	27
	Cape St. Marco . .	37	29	15	13	0	20
	Cape Granitola . .	37	33	57	12	36	39
	Mazzara, Citadel . .	37	39	56	12	33	59
	Marsala, Cape Boco .	37	48	10	12	25	10
	Trapani, Light . .	38	1	53	12	30	18
	Cape St. Vito, Church	38	12	26	12	45	50
	Castel a Mare, Fort .	38	1	51	12	52	43
	Cape de Gallo . . .	38	14	50	13	18	30

LATITUDES AND LONGITUDES.

	(29) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	PALERMO, Light .	38	8	15	13	21	56
	Var. 18° 45′ *W.*						
	— Observatory . .	38	6	44	13	20	15
Sicily.	Cape Zaffarana . .	38	6	0	13	34	0
	Termini, Castle . .	37	57	28	13	42	0
	Cefalu, Cathedral. .	38	0	0	14	3	57
	Caronia	37	59	45	14	26	0
	Cape Orlando . . .	38	7	46	14	44	30
	Cape Calava . . .	38	9	40	14	54	0
	Melazzo, Light . .	38	15	58	15	14	10
	—						
	Eolian Islands,						
	— Stromboli, Church	38	48	12	15	13	10
	— Baziluzza, Ruin .	38	39	50	15	7	54
	— Panaria, S. W. Pt.	38	37	40	15	2	55
	— Penrose Rock . .	38	38	0	14	54	30
	— Lipari, Castle . .	38	27	56	14	57	50
	— Vulcano, Sul Wks.	38	23	19	14	55	56
	— Salina, Amafi Ch.	38	35	40	14	47	35
	— Felicudi, Church .	38	34	5	14	29	37
	— Alicudi, Church .	38	32	41	14	16	30
	— Ustica	38	43	17	13	11	10
Sicilian Islands.	*Var.* 17° 41′ *W.*						
	Ægadian Isles,						
	— Maritimo, Castle	38	1	10	12	3	55
	— Levanso	38	1	38	12	20	29
	— Favignana, Castle	37	56	36	12	17	45
	Pantellaria, Fort . .	36	51	15	11	54	29
	Graham's Shoal .	37	9	0	12	43	0
	Linosa	35	51	50	12	52	9
	Lampedusa, Castle .	35	29	19	12	35	10
	Lampion	35	33	10	12	19	10
	Goza, N. W. Point .	36	3	45	14	8	0
	Malta, Valetta Obs. .	35	53	55	14	30	50
	Var. 17° 21′ *W.*						
	— Point Benhisa . .	35	49	0	14	33	0
	— Telfola Rock . .	35	46	30	14	28	30
	Esquerque or Skirki Rocks, mid. . .	37	46	0	10	47	0
	Keiths' Reef, mid. .	37	50	0	11	9	0
	Galita	37	32	30	8	55	0
	Sorelli Rocks . . .	37	24	50	8	37	0
	—						
	Unie, Church . . .	44	38	19	14	14	42
	Sansego, Mt. Garbe .	44	30	55	14	18	8
	Lossini, Piccolo Ch. .	44	32	1	14	27	57
Islands in the Gulf of Venice.	Pago, Mount S. Vito	44	28	40	14	59	37
	Premuda, Signal Staff	44	20	12	14	36	49
	Selve, Steeple . . .	44	22	31	14	41	53
	Ulbo, Mole	44	22	54	14	46	58
	Scarda, Signal . . .	44	17	16	14	42	20
	Isto, Signal . . .	44	16	40	14	46	19
	Puntadura, Mt. S. Geo.	44	18	10	15	3	13
	Melada, Steeple . .	44	12	48	14	52	38
	Grossa or Lunga,						
	— Punta Bianchi . .	44	9	0	14	49	36
	Peschiera Shoal . .	43	45	36	15	20	37
	Curbavela, E. Point .	43	41	26	15	30	56
	Zuri, Mount Bol . .	43	39	19	15	38	42
	Brazza,						
	— Milna, Steeple .	43	19	29	16	26	57
	— Mount S. Vito .	43	16	43	16	37	18

	(30) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Pomo Rock . . .	43	5	27	15	27	40
	St. Andrea	43	1	40	15	45	30
	Busi, Signal . . .	42	57	42	16	1	3
	Lissa, Mount Hum .	43	1	43	16	6	54
	— Town	43	3	10	16	11	30
Islands in the Gulf of Venice.	Lessina,						
	— Fort Imperial . .	43	10	45	16	27	4
	— Mount S. Nicolo .	43	8	34	16	36	0
	— S. Georgio Tower	43	7	29	17	11	29
	Curzola,						
	— Fort San Blas . .	42	57	25	17	7	59
	— S. Giovanni di Bl.	42	58	5	16	40	34
	Cazza, Signal . . .	42	46	2	16	30	54
	Lagosta,						
	— Mount S. Georgio	42	45	1	16	51	45
	Lagostini Rks. E. end	42	45	51	17	8	52
	Meleda,						
	— Port Pelazza . .	42	47	6	17	22	50
	— Point Grui . . .	42	41	16	17	45	10
	Pelagosa, Signal . .	42	23	44	16	16	3
	Cajola Rock . . .	42	23	0	16	22	0
	Pianosa, Signal . .	42	13	40	15	45	23
	Tremiti, S. Nicola .	42	7	30	15	31	4
	—						
	Fano, N. W. Point .	39	52	15	19	19	15
	Merlera, mid. . . .	39	53	15	19	31	40
	Samotraki, N. W. Pt.	39	46	30	19	27	0
	Corfu, Cape Draste .	39	48	15	19	38	0
	— Tignosa, Light .	39	48	0	19	57	30
	— Citadel, Light .	39	37	0	19	56	0
	— Cape Bianco, Lt.	39	21	0	20	7	0
	Paxo, Gayo Light .	39	11	30	20	12	20
	Anti Paxo, S. E. end	39	8	30	20	15	45
	Leucadia or Santa Maura,						
	— Castle	38	50	10	20	43	15
	— Sisola Rock : .	38	42	0	20	32	30
	— Cape Ducato . .	38	33	30	20	32	45
	— Pt. Lypso Prygo .	38	34	40	20	38	45
Ionian Islands.	Arkudi, S. Point . .	38	32	15	20	43	0
	Meganisi, S. Point .	38	35	20	20	48	30
	Kelamo, S. Point . .	38	34	45	20	52	30
	Kastus, S. Point . .	38	32	30	20	54	45
	Atoke, N. Point . .	38	30	15	20	48	30
	Cephalonia,						
	— Cape Viscardo . .	38	28	40	20	33	0
	— Cape Aterra . .	38	21	30	20	24	15
	— Cape Aji . . .	38	8	40	20	23	30
	— Port Argostoli .	38	10	40	20	29	15
	— Cape Skala . . .	38	3	0	20	46	30
	— Cape Capri . .	38	7	0	20	49	30
	— Point Kelia . .	38	16	30	20	41	30
	Ithaca or Theaki,						
	— Point Marmara .	38	30	0	20	39	0
	— Bathi, entr. . .	38	23	0	20	42	30
	— Point Agiani . .	38	19	20	20	46	0
	Oxia, S. end . . .	38	17	20	21	6	15
	Zante, Cape Skinari .	37	56	50	20	41	30
	— Cape Kieri . . .	37	38	35	20	49	30
	— Point Basilika . .	37	44	0	21	0	40
	— Zante, Castle . .	37	47	20	20	54	15
	— Point Krionera .	37	48	40	20	55	0

LATITUDES AND LONGITUDES.

	(31) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Moncague, N. W. Rock	37	56	30	20	58	30
	Stamphanes,						
	— Convent Island .	37	15	0	21	1	30
	Cerigo, Cape Spati .	36	22	30	22	56	30
	— Kapsali	36	7	20	23	0	0
	— St. Nicolo . . .	36	13	0	23	5	30
	Ovo, middle . . .	36	4	45	23	0	30
	Porri	35	56	0	23	15	15
	Cerigotto, S. Point .	35	49	15	23	18	0
	———						
	Cape Crio or St. John	35	15	45	23	32	35
	Sordi Island . . .	35	34	20	23	27	3
	Grabusa Island . .	35	38	0	23	33	35
	Cape Buso	35	36	38	23	35	30
	Cape Spada . . .	35	40	30	23	44	5
	Canea, Town . . .	35	28	40	24	0	25
Candia.	Cape Maleka . . .	35	35	5	24	8	23
	Retymo, Town . .	35	22	17	24	28	12
	Cape Retymo . . .	35	25	52	24	41	10
	CANDIA	35	21	0	25	8	0
	Cape St. John . . .	35	19	10	25	46	45
	Cape Sidero . . .	35	17	40	26	18	40
	Cape Salimon . . .	35	9	15	26	19	25
	Cape Xacro or Yala .	35	3	0	26	15	25
	Christiana Islands .	34	54	0	26	8	15
	Gaidronisi Island . .	34	52	35	25	43	15
	Cape Matala . . .	34	55	5	24	45	5
	Paxamides Islands .	34	59	40	24	34	50
	Gozzo Island, W. Pt.	34	52	0	24	2	0
	Anti Gozzo	34	56	15	23	59	25
	———						
	Caravi	36	46	25	23	35	30
	Falconeri	36	50	40	23	53	0
	Bello Poulo, N. Pt.	36	57	15	23	26	35
	Spetzia, summit . .	37	15	25	23	9	41
	Hydro, summit . .	37	19	58	23	28	39
	— North East end .	37	23	0	23	35	0
	Poros, Mount Elias .	37	31	12	23	27	50
	Egina, Peak . . .	37	42	7	23	29	40
	St. George d'Arbora	37	28	14	23	55	42
	Macronisi, N. end .	37	45	9	24	8	25
	— South end . . .	37	38	30	24	6	45
Grecian Archipelago.	Zea, Port entr. . .	37	40	0	24	19	0
	— Mount	37	[illegible]	18	24	21	40
	Thermia, summit . .	37	26	14	24	23	36
	— South Point . .	37	18	0	24	22	30
	Andro, Cape Guardia	37	58	0	24	43	0
	— Summit	37	50	8	24	50	22
	Tinos, S. Nichola Rd.	37	33	0	25	8	0
	Miconi, N. W. Mount	37	29	16	25	21	22
	Rhenea, middle . .	37	25	0	25	15	0
	Ghioura, summit . .	37	36	36	24	43	13
	Syra, summit . . .	37	28	56	24	55	28
	Pipero	37	[illegible]	15	24	31	48
	Serpho, summit . .	37	10	24	24	29	36
	Siphanto	36	58	4	24	42	36
	Argentiero, summit .	36	49	20	24	33	23
	Polino, summit . .	36	46	10	24	38	57
	Milo, Town . . .	36	41	42	24	29	36
	— Mount Elias .	36	40	27	24	23	14
	Anti Milo, summit .	36	47	42	24	14	33
	Policandro	36	37	4	24	55	5

	(32) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Skyeno, summit . .	36	39	51	25	6	48
	Nio, summit . . .	36	42	44	25	20	50
	Heraclia, summit . .	36	49	28	25	27	48
	Paros, Mount . . .	37	2	46	25	11	25
	— Naussa	37	7	0	25	15	20
	Anti Paros	36	59	40	25	3	27
	Naxia, Mount Dia .	37	1	51	25	31	4
	— Town	37	6	0	25	22	0
	Karos, summit . .	36	53	29	25	39	52
	Amorga, E. end . .	36	53	30	26	6	0
	Amorga Poulo . . .	36	36	55	25	42	34
	Santorin, Mt. St. Elias	36	21	56	25	28	33
	Christiana Islands. .	36	14	41	25	18	45
	Anaphi or Nanphio .	36	22	21	25	47	9
	Hermonisi or Fidulee	36	32	25	26	9	40
	Tragonisi or						
	Ponticusa, summit .	36	32	48	26	14	4
	Stanphalia, Mt. Veglia	36	32	10	26	19	35
	St. John or Cherni .	36	20	51	26	41	38
	Kaleori or Monks . .	38	9	59	25	18	0
	Skyros, Mt. Cochila .	38	49	48	24	37	5
	— Grand Port, entr.	38	47	30	24	31	0
	Scopelo or Scopoli,						
	— Mount Delphi . .	39	8	13	23	41	50
	Skiathos, N. Point .	39	12	0	23	30	0
	Pelerissa, summit .	39	20	0	24	5	0
	Joura, summit . . .	39	23	40	24	11	0
Grecian Archipelago.	Piperi	39	20	30	24	19	0
	St. Estrati, summit .	39	31	0	25	2	0
	Lemnos, N. W. Pt. .	39	59	0	25	2	30
	— Cape Stala, S. Pt.	39	47	30	25	23	30
	— Pt. Blava, N. E. Pt.	40	2	0	25	28	0
	Tenedos, Peak. . .	39	50	14	26	3	45
	Imbros, summit . .	40	10	36	25	51	20
	Samothraki, summit .	40	26	57	25	35	54
	Thaso, summit . .	40	42	2	24	42	45
	Mytelen, Cape Sigri .	39	15	0	25	52	0
	— Port Longoni, entr.	39	5	0	26	5	0
	— Port Oliveir, entr.	39	1	0	26	33	0
	— Town	39	6	0	26	35	0
	Psara, Mount . . .	38	35	34	25	36	0
	Scio, Northern Mount	38	33	42	26	0	55
	— Cape Mastico . .	38	8	0	25	59	0
	— Town, Lights . .	38	22	20	26	5	0
	Nicaria, S. W. Mount	37	31	9	26	2	38
	Samos, W. Mount .	37	43	44	26	38	21
	— Port Vathi . . .	37	46	0	26	58	0
	Patino or Patmos,						
	— South Mount . .	37	17	2	26	35	14
	Lero, Mount Chidi .	37	10	44	26	51	17
	Calymnos, summit .	36	59	30	26	59	0
	Cos or Stanco,						
	— Mount Christo .	36	49	54	27	13	34
	— Town	36	53	11	27	16	37
	Nisari, summit . .	36	35	30	27	11	0
	Tilo or Piscopi,						
	— N. W. Mount . .	36	26	22	27	20	48
	Karki	36	13	0	27	35	0
	Caso, S. Point. .	35	18	20	26	52	35
	Scarpanto, S. Point .	35	23	30	27	12	55
	— North Point . .	35	50	30	27	11	25
	Scarpenton, N. Point	35	54	20	27	12	25

LATITUDES AND LONGITUDES

	(33) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Rhodes, Mole . . .	36	26	53	28	12	51
	— St. Catharine's I.	35	52	0	27	45	30
	— Cape St. John . .	36	3	45	28	4	0
	Three Brothers . .	35	50	20	27	55	10
	Cape Salizano . . .	35	6	20	32	16	30
	Cape Cormachiti . .	35	23	50	32	57	5
	Cape St. Andrea . .	35	41	40	34	37	25
Cyprus.	Famagousta . . .	35	7	40	33	59	5
	Cape Grego . . .	34	57	50	34	6	25
	Larnaca	34	55	13	33	39	32
	Cape Chiti, Tower .	34	49	55	33	38	15
	Limasol	34	41	15	33	3	45
	Cape Gatte	34	32	50	33	1	35
	Cape Blanco . . .	34	39	20	32	40	15
	Baffa or Paphos . .	34	47	20	32	26	20

XIII. The Coast of AFRICA from the entrance to the MEDITERRANEAN to the CAPE OF GOOD HOPE.

	Places.	Lat. N.			West		
	Cape Spartel . . .	35	47	15	5	54	25
	Larash	35	13	0	6	9	0
	New Salee or Rabat .	34	2	30	6	46	0
	Azamor	33	17	30	8	15	0
Marocco.	Cape Blanco . . .	33	6	0	8	38	0
	Cape Cantin . . .	32	35	0	9	13	20
	Saffie	32	18	10	9	12	0
	Mogadore Island . .	31	30	30	9	44	0
	Cape Geer	30	38	0	9	52	0
	Cleveland Shoal . .	30	45	0	10	27	0
	Santa Cruz	30	28	0	9	42	0
	Cape Non	28	41	0	11	15	20
	River Non, entrance	28	17	0	11	31	0
	False Cape Bojador .	26	25	12	14	12	30
	Cape Bojador . . .	26	7	10	14	30	30
Arab Coast.	Seven Capes . . .	24	41	10	15	0	30
	River Ouro, ent. N. pt.	23	36	18	15	8	30
	Cape Barbas . . .	22	19	30	16	9	10
	Cape Blanco . . .	20	47	0	17	4	30
	Cape Mirik . . .	19	25	0	16	32	0
	Portendik	18	19	0	16	2	20
	Barbara Point . . .	15	55	0	16	32	30
	SENEGAL, Fort St. Louis	16	0	50	16	3	0
	Cape Verd, the Paps	14	43	25	17	30	45
	— North West Pitch	14	44	40	17	32	20
Senegambia.	Goree Island, Town	14	39	50	17	25	0
	Var.* 17° 31′ *W.						
	R. Gambia, Bird I.	13	39	10	16	40	30
	— Cape St. Mary .	13	30	10	16	41	2
	— Bathurst Town .	13	28	0	16	35	20
	Var.* 17° 56′ *W.						
	Cape Roxo	12	23	0	16	51	15
	Bissao, Fort . . .	11	51	0	15	37	10
	Var.* 18° 0′ *W.						
	Bijooga Islands,						
	— Balama I., S. Pt.	11	29	0	15	30	0
	— Tombelly, N. Pt.	11	29	0	15	30	0
	— Galina I., W. Pt.	11	27	40	15	46	30

	(34) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Bijooga Islands,						
	— Orango I., S.E. Pt.	11	3	10	15	55	10
	— West Point . .	11	6	0	16	15	0
	Rio Grande Shoals,						
	— South Breakers .	10	42	20	16	18	10
	— West Breakers . .	11	31	30	16	56	0
	Pullam Island . . .	10	51	42	15	45	5
	Alcatraz Island . .	10	37	10	15	26	30
	Nunez River, entr. .	10	36	0	14	42	20
	Cape Verga . . .	10	19	0	14	23	30
	De Los Islands,						
	— Crawford Island .	9	27	30	13	48	30
	— Tamara I., N. Pt.	9	31	0	13	40	30
	— Tamara I., S. Pt.	9	26	30	13	51	24
	— Factory I., N. Pt.	9	30	15	13	38	15
	Matacong Island . .	9	14	0	13	25	30
	SIERRA LEONE, Cape	8	30	0	13	18	30
	— Free Town . . .	8	29	42	13	11	20
	— King Tom's Point	8	30	6	13	11	30
	— False Cape . .	8	25	50	13	17	50
	Var.* 18° 7′ *W.						
	Cape Schilling . .	8	9	30	13	10	10
	Banana Islands, Peak	8	5	50	13	6	10
	Plantain Is., Gillmonis	7	55	12	13	0	10
Coast of Genowa or Guinea.	Point Tassa . . .	7	55	30	13	2	10
	Sherbro Island,						
	— Cape St. Ann . .	7	35	0	12	58	0
	Sherbro River,						
	— Turtle Is., N. end .	7	40	48	13	4	20
	— York Island . .	7	32	0	12	26	40
	— Sea Bar, S. Point	7	22	48	12	31	30
	Cape Mount . . .	6	44	40	11	25	0
	Cape Mesurada . .	6	18	30	10	48	30
	Grand Bassa . . .	5	56	0	9	55	0
	Grand Sestros . . .	4	39	0	8	6	0
	Cape Palmas . .	4	24	0	7	46	10
	Var. 19° *W.*						
	St. Andrew's River	5	0	0	6	3	0
	Lahou, Town . . .	5	12	0	4	36	0
	Cape Appolonia . .	4	44	0	2	33	0
	Axim	4	47	42	2	17	30
	Cape Three Points .	4	45	0	2	4	15
	Dix Cove, Fort . .	4	48	0	1	59	12
	Elmina Castle . . .	5	5	0	1	22	30
	Cape Coast Castle .	5	6	0	1	13	0
	Anamaboo	5	10	12	1	7	10
	Cormantine Fort . .	5	10	30	1	5	36
	Tantumquery Point .	5	12	30	0	46	48
	Barrakoo Point . .	5	29	0	0	24	0
	Accra	5	32	0	0	13	30
					East		
	Ningo Fort	5	45	0	0	1	48
	Volta River, entr. .	5	47	18	0	42	18
	Cape St. Pauls . .	5	45	0	0	52	18
	Quitta, Fort . . .	5	55	0	0	51	20
	Little Popo	6	15	30	1	36	0
	Grand Popo . . .	6	19	0	1	46	0
	Whyda	6	19	0	2	6	0
	Porto Nova . . .	6	23	0	2	31	0
	Badagry, Mount . .	6	26	0	2	43	30
	Lagos River entr. .	6	26	0	3	22	0
	Var.* 21° 6′ *W.						

TABLE LVI.

LATITUDES AND LONGITUDES.

	(35) Places.	Lat. N. °	′	″	Lon. E. °	′	″
Benin.	Benin River, N. Pt.	5	43	0	5	0	0
	Ramos R., entr. . .	5	5	30	5	23	18
	Cape Formosa . . .	4	21	0	6	5	0
Biafra.	NewCalebarR.,W.Pt.	4	22	20	6	58	30
	Old Calebar River,						
	— Tom Shot's Point .	4	35	0	8	18	36
	Cameroon R.,						
	— South East Pt. . .	3	49	12	9	32	24
	Cape St. John . . .	1	10	0	9	18	40
	Corisco Island . . .	0	54	30	9	17	30
	Cape Esterias . . .	0	37	48	9	18	0
	Gaboon R., Pt. Clara	0	30	30	9	17	30
		South					
	Nazareth River . .	0	37	12	8	57	50
	Cape Lopez . . .	0	36	10	8	40	0
	Var. 19° 8′ *W.*						
Loango.	Cape St. Catharine .	1	51	0	9	11	0
	Setteé River, entr. .	2	23	30	9	31	0
	Point Pedros . . .	2	42	0	9	47	0
	Mayumba Bay . . .	3	22	40	10	35	0
	Var. 21° 4′ *W.*						
	Loango River, entr. .	4	39	30	11	42	0
Congo.	River Congo,						
	— Cape Padron . .	6	8	0	12	9	0
	Ambriz Bay . . .	7	51	0	13	4	0
	Dande Point . . .	8	28	0	13	14	0
	St. Paul de Loando .	8	48	5	13	8	0
	Cape Ledo	9	46	0	13	12	0
	Nova Redonda . .	11	36	42	13	44	40
	St.Philip de Benguela,						
	— Fort	12	34	0	13	20	0
	Salinas	12	53	0	12	53	12
	Elephant Bay, Friars	13	12	18	12	44	10
	Cape Mary, Pillar .	13	25	12	12	31	50
	Cape Martha . . .	13	54	10	12	23	30
	Var. 22° *W.*						
	Little Fish Bay,						
	— Brown's Point . .	15	13	0	12	2	0
	Cape Negro . . .	15	40	42	11	53	20
	Port Alexander . .	15	47	0	11	46	30
Western Coast of Africa.	Great Fish Bay,						
	— Tiger Island,N.Pt.	16	30	12	11	41	0
	Cape Frio	18	23	0	11	57	10
	Cape Cross	21	50	0	13	51	48
	Walwich Bay,						
	— Pelican Point . .	22	52	30	14	22	5
	Hollams Bird Island .	24	37	24	14	27	10
	Angra Pequena . .	26	38	30	15	2	30
	Possession I., S. Pt.	26	58	30	15	7	30
	Orange River . . .	28	38	30	16	22	30
	Cape Voltas . . .	28	44	0	16	26	30
	Var. 29° *W.*						
	Olephant River, entr.	31	40	45	18	9	37
	Cape Donkin . . .	31	54	12	18	14	10
	Cape Deseada . . .	32	18	25	18	17	0
	St. Helena Bay,						
	— Paternoster Point	32	42	12	17	49	10
	Saldanha Bay, N. Pt.	33	1	50	17	48	30
	Point Isser	33	22	18	18	5	40
	Dassen Island . . .	33	26	12	18	1	30
	Back Point	33	33	48	18	14	0
	Robben Island . .	33	47	50	18	17	30

	(36) Places.	Lat. S. °	′	″	Lon. E. °	′	″
Colony of Good Hope.	Table Bay,						
	— Cape Town, Obs.	33	55	12	18	23	35
	— Green Point,Light	33	53	10	18	19	30
	Var. 28° *W.*						
	— Devils Peak . .	33	57	12	18	21	30
	CAPE OF GOOD HOPE .	34	22	0	18	24	24
	— Bellows Rock . .	34	23	48	18	24	30
	False Bay,						
	— Simons Bay,D.Yd.	34	11	18	18	21	0
	— Whittle Rock . .	34	16	30	18	29	0
	— Seal Islands . .	34	8	48	18	30	10
	— Anvil Rock . .	34	22	40	18	26	5
	FalseCapeor Hangklip	34	23	48	18	45	0
	Var. 28° 10′ *W.*						

XIV. ISLANDS, ROCKS and SHOALS in the NORTH ATLANTIC OCEAN, and SOUTH ATLANTIC or SOUTHERN OCEAN.

		North			West		
	Lion's Bank . . .	56	40	0	17	45	0
	Rockal	57	39	32	13	31	16
	Aitkin's Rock? . .	55	19	0	9	58	0
	Brazil Rock . . .	51	10	0	16	0	0
	Chapelle Bank? . .	47	37	0	8	30	0
	Devil's Rocks . . .	46	36	0	13	8	0
	Negre's Rocks, about	48	7	0	21	0	0
	Isle Verte, abt. . .	44	52	0	26	25	0
	Greeve's Ledge, abt.	44	15	0	25	5	0
	Amplimont Rocks? .	42	30	0	24	5	0
	Perseus' Shoal . . .	41	3	0	22	30	0
	Hervagaults Breakers	41	2	0	49	23	0
	Three Chimneys? .	47	54	0	29	40	0
	Gough's Rocks? . .	40	28	0	33	0	0
	Watson's Rock . .	40	18	0	53	40	0
	Whale Rock . . .	38	46	0	25	0	0
	Eight Stones, N.Part?	34	50	0	16	35	0
	St. Mary's Bank, abt.	35	53	0	27	19	0
	Josyna Rock . . .	31	40	0	23	45	0
	Tulloch's Rocks . .	37	27	0	24	45	0
	Breton's Rock, abt. .	39	40	0	41	35	0
	Hume's Bank . . .	39	0	0	64	20	0
	Rocks eastward of						
	Bermudas? abt. .	32	20	0	57	30	0
	Bermudas I., Town .	32	22	20	64	37	40
	Var. 3° *W.*						
	— Wreck Hill . . .	32	15	20	64	50	0
	— North Rock . . .	32	29	0	64	42	50
	Ashton Rock . . .	33	48	50	71	41	20
	Mourand's Bank . .	24	34	0	65	10	0
	Inglefield Bank . .	29	42	0	80	17	0
Azores or Western Is.	Corvo, South Point .	39	41	13	31	3	0
	Flores, Pt. Delgada .	39	33	29	31	8	30
	Var. 18° 30′ *W.*						
	Fayal, S E. point . .	38	30	12	28	41	52
	Pico, summit of Peak	38	26	15	28	28	13
	St. George, S. E. Pt.	38	29	22	27	50	42
	Graciosa, S. E. Pt. .	39	0	0	27	58	0
	Terceira, Brazil Mt. .	38	38	33	27	12	48

TABLE LVI.

LATITUDES AND LONGITUDES.

	(37) Places	Lat. N.			Lon.W.		
		°	′	″	°	′	″
	Terceira, Angra . .	38	39	0	27	14	0
	St. Michael,						
	— Pt. Delgada, City	37	45	10	25	41	30
	— Pt. Ferreria . .	37	54	15	25	55	30
	Var. 25° 0′ *W.*						
	— Pt. de la Marquesa	37	48	10	25	10	20
	Formigas, or Ants .	37	16	50	24	54	18
	St. Mary, Town . .	36	58	0	25	12	33
	— S. W. Point. . .	36	57	31	25	14	18
	— S. E. Point . . .	36	56	47	25	6	0
Madeira Islands.	Porto Santo, Town .	33	2	54	16	18	48
	Var. 23° 30′ *W.*						
	Madeira, E Point .	32	43	50	16	38	2
	— Funchal, Fort . .	32	37	42	16	55	30
	Var. 21° *W.*						
	— West Point . .	32	49	0	17	14	30
	— Brazen Head . .	32	37	18	16	51	42
	Desertas,						
	— North I., N end .	32	36	30	16	33	0
	— South I., S. end .	32	28	30	16	31	18
	Salvages, Great . .	30	7	54	15	54	40
	— Great Piton . .	30	3	30	16	2	30
Canary Islands.	Palma, N. Point . .	28	52	30	17	56	30
	— Sta Cruz. . . .	28	43	0	17	45	0
	— Tasacorta . . .	28	38	0	17	57	0
	Ferro, Valverde . .	27	47	20	17	56	0
	— West Point . . .	27	44	0	18	9	0
	Gomera, Port . . .	28	5	40	17	7	0
	Teneriffe,						
	— Sta. Cruz, Mole .	28	28	0	16	15	0
	Var. 20° 0′ *W.*						
	— South Point . . .	28	1	0	16	42	0
	— Peak	28	16	25	16	39	0
	— Orotava	28	25	0	16	34	0
	Canary,						
	— Isleta, or N.E. Pt.	28	13	0	15	24	0
	— West Point. . .	28	1	20	15	50	0
	— South Point . .	27	45	0	15	37	30
	Fuertaventura,						
	—Lobos Island . .	28	45	0	13	49	0
	— S.W. Point. . .	28	4	0	14	28	50
	Lanzarota,						
	— South Point . .	28	51	0	13	46	0
	— Port de Naos . .	28	58	30	13	33	0
	— N. E. Point . .	29	15	0	13	29	0
	Allegranza Island . .	29	25	30	13	31	0
Cape Verde Islands.	St. Antonio, N. Pt. .	17	12	0	25	9	20
	— East Point . . .	17	5	30	25	2	40
	— West Point. . .	17	4	0	25	25	45
	— Tarafal Bay. . .	16	56	48	25	22	30
	Var. 15° *W.*						
	— South Point .	16	55	0	25	22	0
	St. Vincent,						
	— Porto Grande . .	16	54	0	25	4	0
	St. Lucea, N. Point .	16	49	0	24	50	30
	— East Point . . .	16	46	0	24	45	0
	Branca, center . . .	16	40	0	24	44	0
	Raza, E. Point . .	16	38	0	24	38	30
	St. Nicholas, N. Pt. .	16	42	0	24	24	20

	(38) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
Cape Verde Islands.	St. Nicholas, W. Pt. .	16	38	0	24	30	0
	— Monte Gorda . .	16	37	50	24	23	50
	— East Point . . .	16	34	30	24	3	0
	— South Point . .	16	28	30	24	22	0
	Sal or Salt I., N. Pt.	16	51	20	22	58	30
	— Mordeira Bay . .	16	41	30	23	3	0
	Var. 14° 10′ *W.*						
	— South Point . .	16	34	15	23	0	0
	Bonavista, N. W. Pt.	16	13	20	22	59	40
	— North East Point	16	11	0	22	46	30
	— New Town . . .	16	7	0	22	59	30
	— South Point . .	15	57	0	22	52	40
	Leton Rocks . . .	15	48	0	23	13	0
	Mayo, N. Point . .	15	19	0	23	16	0
	— English Road . .	15	7	30	23	17	0
	— South Point . .	15	6	40	23	14	0
	St. Jago, N. Point .	15	19	30	23	49	30
	— East Point . . .	15	0	30	23	29	0
	— Porto Praya . .	14	53	40	23	34	0
	— S.W. Point . . .	14	58	30	23	47	0
	Fogo, N. Point . .	15	1	15	24	25	0
	— Luz Town . . .	14	53	0	24	34	0
	— Peak	14	56	0	24	23	40
	Brava, Road . . .	14	48	0	24	47	30
Islands in the South Atlantic.	Warley's Shoal, abt. .	5	4	0	21	25	0
	French Shoal . . .	4	5	0	20	35	0
	Penedo de St. Pedro,						
	or St. Paul's Rocks	0	55	0	29	15	0
	Fernando Po,				East		
	— Cape Bullen . .	3	47	15	8	39	21
	— Point William . .	3	45	36	8	45	0
	— Cape Horatio . .	3	46	9	8	54	21
	— Cape Vidal . . .	3	39	18	8	56	20
	-- Cape Barrow . .	3	11	30	8	40	0
	Var. 24° 0′ *W.*						
	— Cape Eden . . .	3	15	30	8	25	5
	— Cape Badgley . .	3	19	42	8	21	40
	— Charles' Folly . .	3	26	48	8	27	40
	— Goat Island, center	3	31	0	8	32	48
	Prince's Island,						
	— Fort St. Antonio .	1	38	0	7	27	23
	— The Brothers . .	1	23	0	7	19	48
	St. Thomas's Island,						
	— Man of War Bay .	0	27	0	6	44	42
		South					
	Annabona, Road . .	1	25	0	5	42	48
					West		
	Bouvet's SandyI., abt.	0	23	0	19	10	0
	Triton's Bank . . .	0	32	0	17	46	0
	Fernando de Noronha,						
	— The Pyramid . .	3	56	20	32	28	50
	Roccas	3	52	12	33	20	0
	Blaesdale's Reef, abt.	0	57	0	41	22	0
	Manoel Luis Rocks .	0	51	25	44	14	45
	Var. 0° 57′ *E.*						
	Sylva's Rocks . . .	0	32	0	44	17	20
	Trinidad, S. E. Point	20	31	0	29	19	0
	Var. 5° *W*						
	Martin Vas Rocks .	20	29	24	28	51	24
	Laurel's Shoal . . .	36	28	0	51	30	0
	Ascension I , Flagstaff	7	55	56	14	23	50

TABLE LVI.

LATITUDES AND LONGITUDES.

	(39) Places.	Lat. S.			Lon.W.		
		°	′	″	°	′	″
Islands in the South Atlantic.	St. Helena,						
	— James Town . .	15	54	48	5	45	20
	Var. 17° 30′ *W.*						
	Tristan da Cunha . .	37	6	1	12	6	50
	Inaccessable I. . .	37	19	0	12	13	0
	Nightingale I. . . .	37	29	0	12	11	0
	Gough's Island . .	40	19	30	9	49	0
	Lennon's Reef, abt. .	37	31	0	4	42	0
					East		
	Whale Rock	37	35	0	7	30	0
	Circumcision Land .	54	16	0	6	14	0
	Malouines or Falkland Islands,				West		
	— Port Egmont . .	51	21	30	60	1	15
	— Ship Harbour . .	51	43	10	61	14	10
	— Cape Porpoise .	52	20	40	59	17	50
	– Solidad or Old Fort St. Louis	51	32	0	58	4	15
	Beauchene Island . .	52	44	30	58	48	0
	Var. 20° 45′ *E.*						
	Resignation I.? . .	50	26	0	42	0	0
	Aurora Islands?						
	— Northernmost . .	52	37	24	47	43	15
	— Middle Island . .	53	2	40	47	55	15
	— Southernmost . .	53	15	22	47	57	15
	Shag Rocks . . .	53	40	0	43	8	0
South Georgia.	Wallis Island . . .	54	0	0	38	29	40
	Cape North . . .	54	4	45	38	15	0
	Var. 11° 15′ *E.*						
	Cape George . . .	54	17	0	36	32	30
	Sandwich Bay . . .	54	42	0	36	12	0
	Q. Charlotte's Cape .	54	32	0	36	11	30
	Coopers Island . .	54	57	0	36	4	20
	C. Disappointment .	54	58	0	36	15	0
	Pickersgill Island . .	54	42	30	36	58	0
	Clerk's Islands . .	55	5	30	34	42	0
Sandwich Land.	Candlemas Islands .	57	10	0	27	13	0
	Saunders Island . .	58	0	0	26	58	0
	Cape Montague . .	58	33	0	26	46	0
	Cape Bristol . . .	59	2	30	26	51	0
	Friesland Peak . .	59	2	0	26	55	30
	Southern Thule . .	59	34	0	27	45	0
	South Orkney's, or Powell's Groupe,						
	— Cape Dundas . .	60	46	30	44	35	45
	— Saddle Island . .	60	37	50	44	52	45
	— West Cape . . .	60	42	0	46	23	52
	Var. 16° 1′ *E.*						
South Shetland Islands.	Clarence Island,						
	— Lloyd's Point . .	61	7	0	54	23	0
	— Cape Bowles . .	61	18	0	54	25	0
	Cornwallis Island . .	61	2	0	54	41	0
	Elephant or Barrow's I.						
	— Cape Valentine .	61	5	0	54	55	0
	Seal Rocks	61	1	0	55	32	0
	O'Brien's Islands . .	62	32	0	56	20	0
	Var. 27° 30′ *E.*						
	Bridgman's I. . . .	62	4	0	56	57	30

	(40) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
South Shetland Islands.	Cape Melville . . .	62	1	0	57	45	45
	North Foreland . .	61	51	0	58	0	0
	Desolation Island . .	62	24	0	60	25	0
	Cape Sheriff . . .	62	26	0	60	40	0
	Var. 28° *E.*						
	Start Point	62	41	30	61	16	30
	Basil Hall's I. center	62	47	30	61	40	0
	James' I., East end .	62	52	45	62	26	30
	— West end . . .	62	49	30	62	55	0
	Jameson's I., center .	63	4	0	62	17	30
	Deception I. East end	62	55	0	60	29	0
	St. George's Bay . .	62	6	0	58	6	0
	Hope Island . . .	63	5	30	56	44	0
	Alexander the First's I.	68	13	0	73	10	0
	Peter the First's I. . .	68	57	0	90	46	0

XV. The Coast and adjacent Islands from the CAPE OF GOOD HOPE to CANTON.

		South			East		
Colony of Good Hope.	CAPE OF GOOD HOPE .	34	22	0	18	24	24
	False Cape or Hangklip	34	23	48	18	45	0
	Var. 28° 10′ *W.*						
	Mudge Point . . .	34	27	12	19	8	30
	Danger Point . . .	34	41	30	19	16	30
	Dyer's Island . . .	34	43	42	19	23	10
	Quoin Point . . .	34	48	48	19	36	40
	Cape Lagullas . . .	34	51	12	19	56	30
	Struy's Point . . .	34	42	24	20	11	0
	Cape Infanta . . .	34	30	50	20	48	0
	Leven Point . . .	34	27	20	21	20	0
	Cape Vaches . . .	34	19	42	21	51	24
	Flesh Point	34	15	0	21	58	0
	Mozelle Bay,						
	— Cape St. Blaize .	34	7	0	22	6	40
	Knysna River, E. Pt.	34	6	30	23	2	40
	Plettenburg Bay,						
	— Cape Seal . . .	34	4	48	23	17	30
	Cape St. Francis . .	34	10	0	24	47	30
	Algoa Bay,						
	— Cape Recif . . .	34	2	10	25	36	10
	— St. Croix I., Peak	33	47	36	25	41	30
	— Doddington Rock	33	57	18	26	6	20
	— Bird Is., eastern .	33	52	5	26	12	50
	— Woody Cape . .	33	46	30	26	9	0
	Point Padrone . . .	33	46	30	26	19	30
	Kowie R., entr. . .	33	33	42	26	45	0
	Great Fish Point . .	33	30	10	27	2	10
	Great Fish R., entr. .	33	27	0	27	2	30
	Keiskamà R. entr. .	33	16	42	27	26	30
	Point Hood	33	3	50	27	52	50
	Buffaloe River,						
	— Cape Morgan . .	32	42	6	28	19	40
	Var. 30° *W.*						
	Hole in the Wall . .	32	3	12	28	56	0
	St. John's River, entr	31	34	30	29	23	40
	Cape Natal	29	53	0	30	57	10
	Fisher's River, entr. .	29	16	18	31	28	0

TABLE LVI.

LATITUDES AND LONGITUDES.

The Eastern Coast of Africa.

(41) Places.	Lat. S.			Lon. E.		
	°	′	″	°	′	″
Point Durnford . .	29	0	12	31	46	30
Cape St. Lucia . .	28	32	30	32	22	30
Cape Vidal	28	9	36	32	33	0
Delagoa Bay,						
— Cape Collatto . .	26	4	0	32	55	50
— Cape Inyack . .	25	58	0	32	57	30
— Elephant I., N. Pt.	25	58	12	32	52	15
— English R. Flagstaff	25	58	12	32	31	42
Lagoa River entr. . .	25	20	36	33	8	0
Inhampura R. entr. .	25	11	36	33	26	30
Cape Corrientes . .	24	7	30	35	25	25
Inhamban Bay, Town	23	51	42	35	19	40
— Mafouroon I. . .	23	44	30	35	22	30
Cape Lady Gray . .	22	56	12	35	36	0
Bazarouta Is., N. Pt.	21	31	0	35	28	0
Inverarity's Shoal .	20	42	30	35	5	10
Chuluwan I., N. Pt.	20	38	12	34	48	30
Sofala, Fort . . .	20	10	42	34	40	55
Luabo Shoals . . .	18	57	40	35	55	0
Quillimane R., Town	17	51	48	36	56	0
— Port Taugalane .	18	1	24	36	56	20
— Senna, Town . .	17	30	0	35	38	48
David's Shoals . .	17	31	30	38	27	12
De Sylva Bank . .	17	18	0	38	46	20
Foga or Fire I. . . .	17	14	21	38	50	18
Raza Island	17	6	30	39	1	20
Trees Island . . .	17	4	18	39	4	50
Macalonga Point . .	16	58	48	39	1	10
Caldeira Island .	16	38	48	39	40	48
Angosha Is., Hurd's I.	16	33	24	39	44	50
Mafamal or Mafamede I.	16	20	30	39	58	48
Huddart's Shoals . .	15	46	42	40	22	50
Mogincale Shoals,						
— North end . . .	15	33	36	40	29	30
— South end . . .	15	36	0	40	27	30
Barracouta Point . .	15	30	0	40	31	0
Mozambique, Fort .	15	1	0	40	41	48
— St. George's I. .	15	2	12	40	43	30
Quintangonya, S. Pt.	14	52	30	40	45	35
Melamo Point . . .	14	25	0	40	45	48
Penda Shoal, E. end .	14	15	0	40	45	30
Laguno Point . . .	14	12	30	40	39	48
Soreessa Point . . .	13	32	48	40	31	55
Badgley Point . . .	13	22	48	40	31	0
Maunhané or Devil's Pt	12	56	30	40	32	40
Pomba, N. Point . .	12	55	48	40	28	0
Var. 14° 30′ *W.*						
Areemba Point . .	12	38	12	40	34	30
Querimba Islands,						
— Foomo I., N. Pt. .	12	31	0	40	34	0
— Querimba I., N. Pt.	12	23	42	40	33	48
— Ibo I., Fort . . .	12	20	0	40	33	0
— Matemo I., E. Pt.	12	13	48	40	34	50
Pangané Point . . .	11	59	30	40	29	50
Isla dos Mattos . .	11	48	42	40	33	10
Zanga Island . . .	11	37	42	40	30	30
Vumba I., E. Pt. . .	11	9	20	40	38	10
Nondo Pt.	11	0	30	40	30	0
Tikomadjy I., N.E. Pt.	10	46	0	40	35	40
Cape Delgado . . .	10	41	12	40	34	36
Roobamba Pt. . . .	10	13	30	40	9	0
Monghou R., E. Pt.	10	7	42	39	56	50

The Eastern Coast of Africa.

(42) Places.	Lat. S.			Lon. E.		
	°	′	″	°	′	″
Lindy R., Fort . .	9	59	30	39	40	0
Masonga River . .	9	45	0	39	41	50
Kisoohara R., N. Pt.	9	26	0	39	33	40
Keelwa, or Quiloa,						
— Pagoda Point . .	9	1	42	39	32	10
Quiloa I. Fort . . .	8	57	0	39	29	0
Songa Songa . . .	8	32	24	39	30	10
Monfeea, W. Point .	7	56	0	39	32	40
— Moresby Point .	7	38	36	39	52	42
Poana Point . . .	7	2	42	39	32	12
Latkanis I.	6	54	12	39	55	30
Zanzibar I., S. Point.	6	27	40	39	27	50
— Town.	6	9	36	39	9	24
— North Point . .	5	42	48	39	15	30
Paugany R.						
— Mazeewy I. . .	5	30	0	39	4	0
Pemba I., S. Point .	5	29	18	39	37	0
Mesal Island,						
— Chak Chak Bay .	5	15	40	39	35	20
— N. W. Point . .	4	52	0	39	38	42
Mombas I., Fort . .	4	4	0	39	38	0
Killeely River, entr.	3	37	48	39	47	50
Maleenda	3	12	48	40	6	10
Formosa Bay,						
— Ras Gomany . .	3	0	0	40	13	30
— Ozy River . . .	2	33	12	40	30	10
Lamoo, Town . . .	2	15	42	40	51	10
Ras Kattow . . .	2	18	42	40	52	30
Patta, Town . . .	2	9	12	40	57	10
Kisingatty	2	6	12	41	7	10
Dundas Is., Peak . .	2	0	0	41	13	0
— Simmanbaya . .	1	45	30	41	26	40
— Port Durnford, N Pt.	1	13	12	41	49	10
— Toola I.	1	0	0	41	58	12
— Thooala I., N. Pt.	0	50	30	42	7	0
— Kismayoo, N. Pt.	0	36	48	42	16	50
Dedalus Shoals . .	0	24	24	42	38	40
Juba R. entr. . . .	0	14	30	42	34	10
	North					
Brava, Town . . .	1	6	48	43	58	15
Torra	1	26	0	44	16	0
Marka	1	44	10	44	46	50
Horealy	1	50	10	44	55	30
Gezerat	1	53	48	45	2	0
Mukdeesha or						
Magadosha . . .	2	1	48	45	19	30
Var. 9° 0′ *W.*						
Murot Hill	2	41	15	46	12	0
Ras Asooad	4	34	10	47	55	30
Ras Awath	5	32	48	48	35	0
Ras Ul Khyle . . .	7	43	30	49	40	30
Ras Mabbere . . .	9	29	0	50	45	0
Ras Hafoon or Orfui .	10	27	48	51	16	40
Hor Hardeea . . .	10	34	30	50	56	0
Ras Banna	11	12	24	51	6	0
Cape Guardafui . .	11	41	4	51	12	24
Ras Asser	11	48	50	51	14	30
Ras Met	11	55	10	50	51	35
Mette Island . . .	11	22	0	48	45	0
Burnt Island . . .	11	17	0	47	21	0
Burburra . . .	10	25	36	45	9	0
Zeyla.	11	15	0	42	54	0

TABLE LVI

LATITUDES AND LONGITUDES.

	(43) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Cape Rasbir . . .	12	12	0	43	25	0
	Abdul Koory I. W. Pt.	12	12	35	52	2	50
	— N. E. Pt. . . .	12	11	30	52	18	0
	Salte's White Rocks .	12	25	30	52	4	10
	Brothers, Durjy I. .	12	6	0	53	2	50
	— Samaong I. . . .	12	10	50	52	51	0
	Karkafahroon Rks. .	12	39	50	52	57	0
	Socotra Island,						
	— Ras Rarby, W. Pt.	12	30	0	53	3	30
	— Galanscea Road .	12	43	0	53	18	10
	— Pyramid Rock . .	12	44	20	53	22	0
	— Tamarin	12	36	40	53	41	0
	— RasShoorguy,E.Pt	12	31	10	54	27	10
	—						
	BabelmandeborPerimI	12	40	0	43	27	30
	High Brothers . . .	12	29	0	43	28	30
	Babelmandeb Peak .	12	41	30	43	31	30
	Ras Ourata	14	36	30	41	21	0
	Dhalia I., E. Pt. . .	15	36	0	40	27	30
	Massowah I. . . .	15	36	0	39	33	0
	Rus Assease . . .	18	26	0	38	12	30
	Suakin, Fort . . .	19	8	0	37	26	0
	Salaka	20	26	30	37	18	30
	Elba Cape	22	4	0	36	56	30
The Red Sea, or Gulf of Arabia.	Ras Benas, Tomb .	23	55	30	35	50	0
	St. John's I. . . .	23	36	30	36	14	0
	Fury Shoal, centre .	24	9	0	35	44	0
	Dedalus Shoal . . .	24	55	30	35	56	30
	Wadder Jumaul I. .	24	34	0	35	14	0
	Cosire	26	7	0	34	21	0
	Brothers	26	21	30	34	54	30
	SUEZ	29	57	0	32	37	0
	Toor Harbour . . .	28	13	20	33	41	0
	Ras Mahommed . .	27	43	15	34	20	0
	Moila	27	39	0	35	34	0
	Cape Bareedy . . .	24	18	0	37	33	0
	Yembo, Fort . . .	24	5	30	38	7	0
	Jidda	21	27	30	39	15	0
	Var. 7° 30′ *W.*						
	Leet	20	7	30	40	31	0
	Coomfidah	19	8	0	41	10	0
	Loheia	15	42	30	42	44	0
	Hodeiah	14	47	30	42	59	0
	Jibbel Teer, centre .	15	32	0	41	55	0
	Zebaya I., S. Pt. . .	15	2	0	42	18	0
	Jibbel Zooger, S. Pt..	13	54	30	42	48	0
	Harnish I., S. W. Pt.	13	39	30	42	43	0
	MOCHA	13	19	0	43	17	30
	Var. 6° 30′ *W.*						
	—						
	Cape St. Anthony. .	12	39	0	44	16	30
	Cape Aden	12	44	0	45	10	30
	Var. 8° 40′ *W.*						
Coast of Arabia.	Cape Bogatshua . .	14	51	0	50	3	0
	Kisseen Point . . .	15	19	30	51	40	0
	Cape Fartak . . .	15	37	30	52	11	0
	Cape Morebat . . .	16	55	0	54	42	50
	Ras Jingera . . .	17	6	50	55	2	0
	Ras Noss	17	23	0	55	10	30
	Curia Muria Isles,						
	— Jibly	17	26	20	56	16	0
	— Hallanny, N.E. Pt.	17	31	15	56	0	0
	— Soda	17	28	0	55	49	0
	— Hasky	17	29	30	55	30	0

	(44) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Ras Garwow or Cape Chancily .	17	51	50	56	16	10
	Ras Madrake or Cape Isolette .	18	58	0	57	45	30
Coast of Arabia.	Massera Island,						
	— South Point . .	20	7	35	58	33	0
	— North Point . .	20	40	10	58	48	35
	Ras Jibsh	21	25	50	59	6	30
	Ras al Hubba . . .	22	14	30	59	44	20
	Ras al Had or Cape Rosalgat .	22	33	10	59	43	10
	Var. 6° 10′ *W.*						
	Muskat	23	37	5	58	41	0
	Burka	23	42	30	57	59	0
	Schenas	24	45	0	56	33	40
	—						
	Ormus, Fort . . .	27	5	30	56	29	30
	Larck Hill	26	52	0	56	23	0
	Kishma Island,						
	— Kishma, Town . .	26	57	30	56	19	0
	Luft	26	54	0	55	50	0
	— S. W. Pt. . . .	26	32	30	55	24	0
	— N. W. Point. . .	26	39	30	55	22	0
Persian Side of the Gulf of Persia.	Angar or Anguam I.,						
	— N. Point	26	42	0	55	56	0
	— S. Point	26	37	0	55	54	0
	Great Tumb I. . . .	26	15	0	55	24	0
	Cape Bostana . . .	26	28	50	54	39	30
	Bomosa Island . .	25	54	0	55	8	0
	Polior or Belior I.,mid.	26	18	0	54	35	0
	Kaez or Kush Island.	26	29	0	54	2	0
	Hinderabia	26	41	0	53	40	0
	Busheab, E. Point .	26	48	0	53	25	0
	Cape Nabon . . .	27	23	0	52	40	0
	Congoon	27	48	45	52	9	0
	Ras Mulgurrum . .	27	50	30	51	38	0
	Zezarine I.	27	58	30	50	8	0
	Keyn Island . . .	27	47	0	50	9	30
	Busheer	29	0	0	50	51	30
	Var. 5° 0′ W.						
	Karack Island, Fort .	29	16	45	50	21	0
	Ras Poshoon . . .	29	39	0	50	28	0
	Ras-el Tombe . . .	29	55	30	50	11	30
	BASRA or BUSSORA .	30	29	30	47	40	0
	Phelechi I., S. E. end	29	23	0	48	19	0
	GRAEN	29	22	50	47	58	23
Arabian Side of the Gulf of Persia.	Khubber Island . .	29	4	0	48	24	0
	Garwow Island . .	28	49	0	48	42	0
	Malmaradam Island .	28	40	0	48	35	0
	Ras-ul-Lur	29	21	0	48	5	0
	Ras-ul-Zoor . . .	28	44	0	48	16	0
	Durable Shoal . . .	26	57	0	50	21	0
	Katif Bay, N. Pt. . .	26	37	15	50	14	0
	Barhrein I., anch. off	26	15	30	50	40	0
	Var. 5° 40′ *W.*						
	Koor Hussan . . .	26	4	30	51	11	0
	Ras Reccan	26	11	0	51	17	0
	Hawlool	25	40	15	52	26	0
	Sherarow	25	2	0	52	18	0
	Daeny	24	57	30	52	25	0
	Seir Beni Yass . . .	24	18	0	52	46	0
	Dalmy, S. end . . .	24	27	30	52	27	0
	Arzenie	24	48	0	52	42	15
	Jernain	24	56	0	52	59	45
	Dauss	25	8	30	53	0	45

LATITUDES AND LONGITUDES.

	(45) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
Arabian Side of the Gulf of Persia.	Zircooa or Zara	24	52	0	53	13	15
	Seir Abonaid	25	14	0	54	22	0
	Ras Luffan	25	54	30	51	36	0
	Ras-el-Allarch	25	0	0	51	38	30
	Jezurab-ain-Lassart	24	46	0	51	37	0
	Ras Boogmais	24	34	30	51	31	0
	Goodwin's Islands	24	35	0	51	43	0
	Yassaret Island	24	14	0	51	58	0
	Ras-el-Machereeb	24	17	0	51	45	0
	Jibbul Hadwareah	24	12	0	52	47	0
	Stanner's Shoal, N. end	24	40	0	53	17	0
	Mount Jibbul Alli	25	2	0	55	14	0
	Abothubbee	24	29	0	54	32	0
	Debai	25	16	30	55	24	45
	Sharga	25	21	45	55	29	15
	Aymaun	25	25	15	55	33	0
	Amulgawein	25	35	15	55	41	45
	Red Island, Town	25	43	0	55	55	15
	Ras-el-Khyma	25	48	15	56	4	15
	Raumps	25	53	0	56	8	30
	Shaum, Towers	26	2	0	56	11	15
	Boukha Point	26	9	30	56	14	15
	Cape Jedda or Yeddu	26	13	45	56	16	30
	Ras Sheik Munsoud	26	16	16	56	19	0
	Perforated Rock	26	23	54	56	27	32
	Great Quoin	26	30	25	56	34	20
	Cape Musseldom	26	23	45	56	35	10
	Kooe Mubarrack, or Blessed Hill	25	52	0	57	20	0
	Cape Jask	25	38	0	57	48	0
	Churbar	25	16	0	60	35	0
	Cape Gwadur	25	4	0	62	17	0
	Cape Arubah	25	7	0	64	32	0
	Cape Monze	24	51	0	66	35	0
	Bate Castle	22	28	30	69	20	0
	Point Jigat	22	13	30	68	52	0
	Diu Head	20	42	0	70	56	30
	Scarbett Island	20	55	30	71	36	30
	Cambay	22	24	0	72	30	0
	SURAT, Castle	21	11	0	73	2	34
	Vaux's Tomb	21	4	30	72	47	44
	Var. 0° 30′ *W.*						
Malabar Coast.	Damaun	20	22	0	73	2	45
	Omergon	20	10	30	72	54	30
	St. John's High Land	20	3	0	72	49	0
	Basseen Fort	19	19	0	72	55	24
	BOMBAY, Flag Staff	18	55	48	72	54	24
	— Lighthouse	18	53	45	72	52	54
	Var. 1° 0′ *W.*						
	Henery & Kenery Is.	18	42	20	72	53	0
	Coullaba Island	18	37	20	72	56	30
	Chaoul	18	32	30	73	0	0
	Bancoot	17	56	40	73	7	54
	Severndroog	17	47	30	73	9	0
	Dabul	17	46	0	73	11	0
	Zyghur Point	17	16	0	73	14	30
	Geriah	16	31	0	73	22	24
	Angria's Bank, mid.	16	28	0	72	7	0
	Vingorla Rocks	15	51	0	73	35	0
	GOA	15	28	20	73	55	30
	Algoado Point	15	29	30	73	50	30
	Marmagoa, Fort	15	24	30	73	51	0
	St. George's Island	15	22	0	73	50	0

	(46) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
Malabar Coast.	Cape Ramas	15	5	15	73	58	30
	Carwar Head	14	47	0	74	14	0
	Anje-diva	14	45	30	74	10	0
	Merjee River	14	30	0	74	28	45
	Onore	14	16	0	74	34	0
	Fortified Island	14	19	0	74	26	0
	Pigeon Island	14	2	30	74	24	0
	Barcelore, Peak	13	50	0	74	54	0
	St. Mary's Rocks, — Largest	13	31	0	74	38	0
	Premeira Rocks	13	11	0	74	36	0
	Mangalore	12	51	30	74	53	0
	Mount Dilly	12	1	40	75	15	45
	Cananore	11	52	30	75	26	0
	Tillicherry	11	44	40	75	33	0
	Sacrifice Rock	11	30	0	75	35	30
	Calicut	11	15	0	75	50	0
	Chitwa, Church	10	33	0	76	8	30
	Cochin	9	57	30	76	18	30
	Quilon	8	53	0	76	38	0
	Anjenja Roads	8	39	25	76	49	30
	CAPE COMORIN	8	5	0	77	35	0
	Manapar Point	8	22	0	78	7	0
	Punnecoil	8	41	0	78	12	0
Coromandel Coast.	Point Calymere	10	17	30	79	56	0
	Negapatam, Fort	10	45	30	79	55	0
	Five White Pagodas	10	49	0	78	54	30
	Tranquebar	11	1	30	79	55	0
	Devicotta	11	24	0	79	52	0
	Porto Nova	11	31	0	79	49	0
	Cuddalore	11	43	0	79	50	0
	Pondicherry	11	55	41	79	53	45
	Sadras	12	32	0	80	13	30
	MADRAS, — Fort St. George	13	4	10	80	19	41
	Var. 0° 35′ *E.*						
	Pullicate, Flagstaff	13	25	0	80	22	0
	Armegon	13	59	0	80	20	0
	Point Divy	15	57	30	81	14	15
	Musilipatam	16	10	0	81	12	15
	Point Gordewar	16	48	0	82	17	0
	Coringa	16	49	0	82	13	0
	Visagapatam	17	42	30	83	26	0
	Bimliapatam	17	53	0	83	34	0
	Chicacole	18	12	0	83	58	0
Bengal.	Ganjam	19	22	30	85	10	0
	Jagernaut Pagoda	19	48	21	85	45	0
	Black Pagoda	19	52	15	86	8	0
	False Point	20	19	38	86	59	0
	Point Palmiras	20	41	0	87	11	0
	Balasore River, ent.	21	28	0	87	12	0
	Ingerlee Pagoda	21	47	0	87	54	0
	Kedgeree, Post Office	21	52	30	87	59	0
	Western Brace, — South end	21	9	0	87	40	0
	Western Sea Reef, — South end	21	0	0	87	57	0
	Eastern Sea Reef, — South end	20	59	0	88	15	0
	Red Reef Buoy	21	9	0	88	13	0
	Sauger Sand, S. end	21	2	0	88	26	0
	Sauger Island, S. Pt.	21	34	0	88	9	0
	Mud Point	21	56	0	88	7	0
	CALCUTTA, — Fort William	22	34	38	88	21	12

TABLE LVI.

LATITUDES AND LONGITUDES.

	(47) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Chandernagur . . .	22	51	26	88	28	40
Chittagong.	Islamabad or Chittagong . . .	22	21	0	91	51	0
	Kuttubdea I., N. end	21	55	0	91	52	0
	Red Crab Reef. . .	21	25	0	91	56	0
	Elephant Point . .	21	10	0	92	4	0
	Shapooree Island . .	20	46	0	92	20	0
	St. Martin's, Tree I. .	20	38	0	92	20	0
	Oyster Rock . . .	20	12	0	92	31	0
Aracan.	Mosque Point . . .	20	6	45	92	55	0
	Terribles, middle . .	19	25	0	93	20	0
	Cheduba Rocks . .	18	57	0	93	26	0
	Cheduba.	18	49	0	93	44	0
	Wangquong or Tree I.	18	26	0	93	56	0
	Foul Island. . . .	18	4	0	94	9	0
Ava.	St. John's or Church Rocks	17	28	0	94	23	0
	CalventuraRks.,N.W.	16	55	0	94	15	30
	Buffalo Rocks, S. end	16	19	0	94	12	0
	C. Negrais, — Pagoda Point . .	16	2	0	94	13	0
	Diamond Island . .	15	51	30	94	18	0
	Aguada Reef, S. end .	15	41	0	94	14	0
Pegu.	Rangoon River, — Elephant Pagoda .	16	28	0	96	23	45
	RANGOON, Town . .	16	45	0	96	13	0
	Var. 2° 0′ *E.*						
	Martaban, Town . .	16	32	0	97	37	0
	Quekmi Pagoda . .	16	4	30	97	34	0
	Amherst Town . . .	16	4	30	97	35	0
	MuscosIslands,S.end	13	47	0	97	50	0
	Tavay Point . . .	13	32	0	98	11	30
	Tavay Town . . .	14	5	0	98	12	0
	Tavay Island N. end	13	13	0	98	16	30
	Mergui	12	26	30	98	37	30
	Tanasserim I., N.end	12	36	0	97	49	0
	Cabossa Island . .	12	48	0	97	53	0
	West Canister . . .	12	41	15	97	45	0
	Torres Islands,W.end	11	48	0	97	28	0
	Pine Tree Island . .	10	20	0	98	19	0
	Horsburgh's I. . .	10	11	30	97	55	0
	Roe's Bank, N. end .	10	2	0	96	45	0
	Middle Island . . .	9	3	0	97	50	0
	Perforated Island . .	8	49	30	97	49	0
	Seyer Island, S. end .	8	28	0	97	40	0
	Junkseylon I., S. end	7	46	0	98	20	0
	Slipper Island . . .	7	20	0	98	49	0
	Pulo Bouton, Dome .	6	33	0	99	20	30
	Pulo Ladda, Peak .	6	21	0	99	50	0
Malay Coast.	Queda	6	6	0	100	21	0
	Pulo Pera	5	42	0	99	1	0
	Pulo Penang, or Pr. of Wales Island, — Fort Cornwallis .	5	25	0	100	21	30
	Salangore Hill . . .	3	20	0	101	17	0
	Parcelar Hill . . .	2	51	0	101	25	30
	Cape Rachado . . .	2	26	0	101	51	0
	MALACCA, Fort . .	2	12	0	102	15	0
	Mount Moar . . .	1	59	0	102	41	0
	Mount Formosa . .	1	49	0	102	55	0
	Pulo Pisang . . .	1	28	0	103	14	0
	Tanjong Boulus . .	1	15	0	103	31	0
	Singapore, Town . .	1	17	22	103	51	0
	Point Romania . .	1	22	30	104	17	0
	Tringany River, entr.	5	21	0	103	4	0

	(48) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	SIAM River, entr. .	13	29	40	101	15	0
	Bankok	13	58	30	100	34	0
	Ko-si-chang Harbour	13	12	0	100	55	0
	Cambodia R., W. end	9	35	0	106	20	0
	— mid. entr. abt. . .	9	55	0	106	30	0
	Cape St. James . .	10	16	41	107	4	15
	Saigon, City . . .	10	50	0	106	43	0
	Britto's Bank, centre.	10	30	42	107	49	0
	Point Ke-ga . . .	10	41	30	108	4	0
	Pulo Ceicer de Terre .	11	13	0	108	48	0
	Cape Padaran . . .	11	21	0	109	0	0
	False Cape Varella .	11	44	0	109	12	0
	Camraigne Hr., entr.	11	49	0	109	12	0
	Water Islands, S.end	12	2	0	109	19	0
	Pyramid Island . .	12	21	0	109	22	0
	Three Kings . . .	12	38	0	109	27	0
	Cape Varella . . .	12	55	0	109	21	30
	Pulo Cambir . . .	13	33	0	109	20	0
	Cape San-ho . . .	13	44	0	109	14	0
	Buffalo Island . . .	14	11	0	109	14	0
	Pulo Canton . . .	15	23	0	109	6	0
	Cape Turon	16	5	0	108	15	0
	Cape Choumay . .	16	21	0	107	52	0
	Hue-fo River, entr. .	16	36	0	107	16	0
	Tiger's Island . . .	17	10	0	107	22	0
	Now-chow	20	58	0	110	26	0
	Tien-pak, — Ty-foong-Kyoh .	21	22	30	111	13	0
	Ty-chook-chou . .	21	26	0	111	24	0
	Song-yue Point . .	21	31	0	111	40	30
	Hai-ling-shan, — Mamu-chou. . .	21	34	0	111	50	0
	Ty-oa Point . . .	21	43	0	112	15	0
	Ty-wok	21	39	0	112	7	0
China.	Mandarine's Cap . .	21	28	0	112	22	30
	Mong-chow . . .	21	39	0	112	29	0
	Haw-cheun or False St. John, — S. W. entrance . .	21	35	0	112	31	30
	Wy-caup Island . .	21	34	0	112	47	30
	Lieu-chew	21	36	0	112	53	0
	Wizard Rocks . . .	21	47	0	113	1	30
	Ty-kan Island . . .	21	52	0	113	2	0
	Cou-cock I., S.W. Pt.	21	50	0	113	7	30
	Tyloo, S. end . . .	21	52	30	113	14	30
	Typa, Roads . . .	22	8	0	113	32	0
	MACAO, Town. . .	22	10	30	113	32	0
	CANTON, Factory .	23	7	10	113	14	0

XVI. Islands, Rocks, and Shoals, in the INDIAN OCEAN.

	South			East		
Telemaque Rock? .	38	12	0	22	0	0
Fortune Shoal? . .	33	8	0	43	5	0
Augusta Shoal? . .	33	44	0	36	16	0
Otter's Shoal?. . .	33	43	0	36	30	0
Barker's Rock? . .	37	43	0	32	5	0
Dutch Bank? . . .	37	20	0	38	52	0
Prince Edward's Isles — North end . . .	46	40	0	38	6	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(49) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	— South end	46	53	0	37	46	0
	Crozet's or Desert Is.,						
	about	46	45	0	48	0	0
	Necklegal?	40	48	0	54	0	0
	Kerguelen or						
	Desolation Island,						
	— Christmas Hr.	48	41	15	69	2	15
	Var. 20° 20′ *W.*						
	— Cape Digby	49	23	30	70	32	0
	— Cape George	49	54	30	70	12	15
	— Port Paliser	49	3	15	69	35	0
	St. Paul's Island	38	42	0	77	52	0
	Amsterdam Island	37	52	0	77	52	0
	Cloates Island?	22	0	0	112	30	0
	Tryal Rocks?	20	10	0	110	0	0
	Christmas Island	10	32	0	105	33	0
	Cocos or Keelings Is.						
	— Northernmost	12	0	0	97	4	0
	True Briton's Island?	9	30	0	89	14	0
	——						
	Cape St. Mary	25	38	54	45	1	42
	Var. 21° 0′ *W.*						
	Star Reefs, S. end	25	24	30	44	12	36
	Leven Island	25	12	30	44	12	48
	Barracouta Island	25	3	0	44	2	12
	St. Augustine's Bay,						
	— Sandy Island	23	38	24	43	33	12
	— Tent Rock	23	35	24	43	40	30
	Cape St. Vincent	21	54	24	43	15	12
West Coast of Madagascar.	Mourondava	20	18	18	44	14	12
	Cape St. Andrew	16	11	24	44	25	48
	Boyanna Bay, N. ent.	15	59	0	45	18	12
	Bembatooka Bay,						
	— Majunga Point	15	42	54	46	15	12
	Makumba Island	15	42	0	45	52	24
	Var. 12° 0′ *W.*						
	Majambo Bay, entr.	15	11	42	46	54	12
	Nareenda Bay, entr.	14	40	18	47	21	18
	Luza River, entr.	14	36	54	47	37	54
	Sancasse Island, N.Pt.	14	30	42	47	30	0
	Mc. Cluer Point	14	15	0	47	44	0
	Passandava Bay,						
	— Nine Pin Island	13	28	12	48	9	48
	Var. 12° 30′ *W.*						
	Dalrymple Bay, entr.	13	30	0	47	56	30
	Nos Beh I., N. Pt.	13	12	12	48	13	30
	Minow Island, N. Pt.	12	49	30	48	33	48
	Cape St. Sebastian	12	26	12	48	40	36
	Woody Island	12	16	42	48	36	0
	Port Liverpool, N. Pt.	12	3	18	49	6	12
	Cape Amber, N.E.Pt.	11	57	30	49	13	48
	Diego Suarez Bay, ent.	12	10	12	49	18	48
	Var. 11° 0′ *W.*						
	British Sound, entr.	12	13	48	49	18	18
	Cape Lowry	12	35	0	49	34	36
	Port Looké, E, Point	12	44	12	49	41	48
	Port Leven,						
	— Nosh How Island	12	47	48	49	48	12
	Andrava Bay, S.E. Pt.	12	56	48	49	51	18
	Manambatoo	13	14	12	49	53	12
	Vohemar Point	13	23	30	49	58	0
	Cape East, Town	15	14	24	50	25	12

	(50) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Antongil Bay,						
	— Durnford Noss	16	0	0	50	6	12
	— Port Choiseul	15	27	18	49	47	0
Eastern Coast of Madagascar Island.	— Mananhar	16	9	30	49	41	0
	— Cape Bellones	16	14	0	49	48	48
	Tantang	16	42	30	49	41	6
	Point Larreé	16	50	18	49	46	48
	St. Mary's I., N. Pt.	16	40	30	49	59	36
	— South Point	17	7	18	49	45	42
	— Isle Madame	17	0	0	49	48	48
	Var. 15° 0′ *W.*						
	Fenerive, Town	17	23	0	49	23	0
	Foule Point	17	40	24	49	32	0
	Var. 16° 0′ *W.*						
	Plumb Island	18	2	48	49	24	0
	Tamatave Point	18	10	6	49	23	18
	Fong Isles	18	26	30	49	20	24
	Vatoo Madré	18	39	48	48	52	48
	Manooroo	19	55	0	48	47	0
	Fanantara	20	51	12	48	28	0
	Rangazarak	20	58	12	48	27	24
	Footak	24	4	0	47	26	12
	Manambatoó	24	17	18	47	19	48
	Loodatoo	24	36	42	47	12	12
	St. Luce Bay, N. Isle	24	44	42	47	9	0
	Point Ytapere	24	59	42	47	2	36
	Fort Dauphin	25	1	18	46	57	0
	Var. 21° 0′ *W.*						
	——						
	Europa Island or						
Mozambique Channel.	Bassas da India	22	22	30	40	19	0
	Bassas da India or						
	Europa Rocks, E. Pt.	21	29	0	39	35	30
	Var. 22° 0′ *W.*						
	Barren Islands,						
	— North Island		18	6	43	41	24
	— South Island	18	33	54	43	51	0
	Coffin Island	17	29	0	43	42	0
	Juan de Nova	17	3	30	42	42	18
	Chesterfield Bank	16	17	30	43	50	24
	——						
	Mayotta, Peak	13	11	0	45	11	0
	— North Point	12	36	0	45	6	30
Comoro Islands.	Johanna, Town	12	11	0	44	22	18
	— Highest peak	12	13	30	44	21	18
	Mohilla, N. Point	12	13	0	43	43	0
	Var. 12° 30′ *W.*						
	— East Point	12	20	0	43	55	30
	Comoro, N. E. Point	11	19	30	43	34	0
	— South East Point	11	54	0	43	28	0
	— South West Point	11	55	0	43	22	0
	——						
	Glorioso Islands	11	34	48	47	19	0
	Aldabra Island, E. Pt.	9	26	30	46	29	30
	— N. W. Point	9	21	30	46	6	48
	Assumption I., S.E. Pt.	9	46	18	46	28	48
	Var. 13° 42′ *W.*						
	Cosmoledo Group,						
	— North Island	9	38	12	47	36	12
	— Menai Island	9	42	12	47	32	30
	— Wizard Island	9	43	12	47	40	12
	Astove Island	10	6	30	47	43	18

TABLE LVI.

LATITUDES AND LONGITUDES.

	(51) Places	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Farquhar's Islands or Juan de Nova,						
	— North Island	10	6	42	51	7	48
	Var. 8° 30′ *W.*						
	— Western Island	10	12	42	50	56	36
	— Southern Island	10	21	12	51	0	48
	Mac Leod's Bank,						
	— North end	9	53	0	50	21	30
	— South end	10	0	0	50	19	0
	St. Pierre I., E. Pt.	9	18	42	50	50	48
	Providence Island	9	14	0	51	5	30
	Providence Resf, S end	9	33	18	50	58	30
	Wizard Breakers	8	50	0	51	7	30
	——						
Amiranté Islands.	St. Francis	7	9	42	52	41	36
	Bijoutier	7	3	36	52	42	54
	Alphonse	7	0	30	52	42	36
	Var. 7° 54′ *W.*						
	Boudeuse	6	10	54	52	51	0
	De Neuf	6	14	0	53	9	12
	Marie Louise	6	9	0	53	12	42
	Etoile	5	47	48	53	3	12
	Poivre	5	41	0	53	17	42
	Des Roches, E. Pt.	5	40	0	53	39	0
	St. Joseph, E. Pt.	5	27	30	53	32	24
	Daros	5	24	36	53	23	21
	Eagle	5	7	12	53	23	30
	——						
	African Is., N. Id.	4	53	30	53	28	18
	— South Island	4	55	12	53	28	0
	——						
Seychelle Islands.	Mahé, Town	4	37	30	55	25	0
	Var. 7° *W.*						
	— S. Point	4	48	42	55	31	0
	St. Ann's, S. W. Pt.	4	36	0	55	28	18
	Silhouette, N. Pt.	4	27	0	55	11	30
	North, N. Pt.	4	22	18	55	12	48
	La Digue, peak	4	21	12	55	50	0
	Mary Ann	4	19	24	55	55	30
	Praslin, W. Pt.	4	17	24	55	39	0
	Curieuse	4	16	12	55	42	12
	Aride	4	12	30	55	38	30
	Reciffe	4	34	48	55	45	0
	Frigate	4	35	12	55	56	0
	Dennis	3	48	12	55	38	12
	Bird	3	42	42	55	10	30
	——						
	French or Swan's Shoal	4	0	0	54	32	0
	Dupont's Shoal	4	15	30	54	23	0
	Platte Island	5	51	36	55	23	18
	Coetivy Island	7	9	0	56	13	30
	Fortune's Bank	7	7	0	56	57	0
	Agalega Is., N. end	10	24	0	56	27	30
	Saya de Malha Bank,						
	— North end, about	8	35	0	59	58	0
	Tromelin or Sandy I.	15	53	12	54	31	18
	Cargados Garayos Bk.						
	— Albatross Island	16	11	18	59	40	6
	— North Island	16	21	54	59	43	18
	— Establishment	16	25	12	59	41	30
	— Pearl Island	16	31	30	59	34	12
	— Cocoa Island	16	47	24	59	35	6

	(52) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Rodrigue Island	19	41	0	63	20	0
	Var. 13° 0′ *W.*						
	Mauritius or Isle of France,						
	— Round Island	19	50	30	57	45	0
	— Port Louis	20	9	56	57	28	41
	Var. 14° 20′ *W.*						
	— Cape Brabant	20	27	0	57	14	0
	— Bourbon or Grand Port	20	22	0	57	41	0
	Bourbon Island,						
	— St. Dennis	20	52	30	55	26	30
	— St. Paul	20	59	50	55	13	54
	——						
Chagos Archipelago.	Speaker s Bank, S. end	5	0	0	72	32	0
	Sandy Isles	5	17	0	72	39	0
	Solomon Isles	5	23	0	72	23	0
	Peros Banhos Islands,						
	—N. E end	5	16	0	71	57	0
	Eagle Islands, Northm.	6	11	0	71	29	0
	Three Brothers	6	9	0	71	39	0
	Danger Island	6	21	0	71	23	0
	Six Islands	6	37	0	71	31	0
	Pitt's Bank, S.W. end	7	27	0	71	21	0
	Centurion's Bank	7	40	0	70	52	0
	Ganges Bank	7	26	0	70	59	0
	Chagos or Diego Garcia Island, S. end	7	29	0	72	27	0
	Owen's Bank	6	46	30	70	17	0
	——	North					
	Bale of Cotton Rock?	5	18	0	88	20	0
	——						
Maldiva Islands.	Pona Molulique,	South					
	— South Side	0	41	0	73	20	0
	— N E. Side	0	33	0	73	25	0
	— Addon Island	0	21	0	73	35	0
		North					
	Suadiva Atoll, S. Side	0	9	0	73	15	0
	— N E. Side	0	59	0	73	34	0
	Adoumates Atoll,						
	— South Side	1	49	0	73	33	0
	— N. E. Side	2	9	0	73	46	0
	— N. W. Side	2	7	0	73	35	0
	Collomandour Atoll,						
	— South Side	2	13	0	73	21	0
	— N. W. Side	2	30	0	73	8	0
	— Long Island	2	21	0	73	8	0
	Male Atoll,						
	— Maldiva or King's I.	4	10	0	73	42	0
	Gafor Atoll, N. Side	4	50	0	73	33	0
	Cardiva Island	4	56	0	73	34	0
	Todu Island	4	36	0	73	13	0
	Tilla dou Matis, or Head of the Isles	7	6	0	73	7	0
	——						
Laccadive Islands.	Minicoy or Maling I.	8	17	0	73	19	0
	Kalpeni, center	10	7	0	73	55	0
	Underoot	10	48	0	73	57	0
	Elicalpeni Bank	11	15	30	74	17	0
	Seuhate-par, S. Id.	10	0	0	72	35	0
	Courutte Island	10	34	0	72	57	0
	Pittie	10	48	0	72	48	0

(53)	Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
Laccadiva Islands.	Cardamum	11	14	0	73	10	0
	Kittan	11	29	0	73	21	0
	Chittae	11	42	0	73	1	0
	Aucutta, center . .	10	51	30	72	28	0
	Bingaro	10	55	0	72	35	0
	Peremul-par . . .	11	9	0	72	26	0
	Betra-par	11	35	0	72	31	0
	Cherbaniani Bank,						
	— Breakers on the W. extr.	12	22	0	72	7	0
Ceylon Island.	COLOMBO	6	57	0	79	57	0
	Adam's Peak . . .	6	52	30	80	34	30
	Point de Galle, Flagst.	6	1	0	80	18	0
	Matura	5	58	0	80	38	0
	Dondra Head . . .	5	56	0	80	41	0
	Great Basses . . .	6	11	0	81	36	0
	Little Basses . . .	6	24	30	81	49	0
	Aganis, South part .	6	50	0	81	59	0
	Baticolo	7	44	0	81	50	0
	Friar's Hood . . .	7	25	0	81	42	0
	Venloo's Bay . . .	7	57	0	81	41	0
	Foul Point	8	30	0	81	26	15
	TRINCOMALE,						
	— Flagstaff . . .	8	33	30	81	21	0
	Var. 1° 9′ *W.*						
	Pigeon Island . . .	8	41	0	81	20	0
	Molewal House . .	9	13	0	80	56	30
	Palmeira Point . .	9	48	50	80	23	0
	Point Pedro . . .	9	49	35	80	20	0
Andaman Islands.	Preparis I., S. end .	14	49	0	93	40	0
	Great Coco, center .	14	5	0	93	26	30
	Little Coco, center .	13	58	30	93	18	0
	Great Andaman,						
	— C. Price, N.E. Pt.	13	34	0	93	9	0
	—Port Cornwallis, ent.	13	18	0	93	11	0
	— South end . . .	11	30	0	92	56	0
	North Centinel, center	11	33	0	92	24	0
	Little Centinel . .	11	0	0	92	21	0
	Sisters	11	10	0	92	58	0
	Little Andaman, S. end	10	26	0	92	40	0
	Flat Rock	11	8	0	93	40	0
	Barren Island . . .	12	17	0	93	54	0
	Narcondam . . .	13	24	0	94	12	0
Nicobar Islands.	Car-Nicobar . . .	9	10	0	92	56	0
	Batty Malve . . .	8	46	30	93	2	0
	Chowry	8	28	30	93	12	0
	Terressa, S. Point .	8	13	0	93	20	0
	Katchall, W. Point .	7	54	0	93	29	0
	Noncowry Harbour .	8	0	0	93	41	0
	Meroe	7	29	0	93	46	0
	Great Nicobar, S. end	6	45	0	94	0	0

XVII. Islands, Rocks, and Shoals, between the INDIAN and PACIFIC OCEANS, from Sumatra to New Guinea.

Places.	°	′	″	°	′	″
Pulo Rondo. . . .	6	4	30	95	14	0
Pulo Brasse, N. Point	5	46	0	95	6	0
— East Point . . .	5	42	0	95	13	0

(54)	Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Pulo Way, E. Point .	5	46	0	95	27	0
	— West end . . .	5	48	0	95	18	0
	Pulo Nancy, E. Point	5	40	0	95	17	0
	Cocos Isles	3	6	0	95	32	0
	Hog I., N.W. Point .	2	50	0	95	50	0
Islands near the Western Coast of Sumatra.	— South end . . .	2	21	0	96	18	0
	Western Banjack,						
	— South Point . .	2	0	0	96	54	0
	Passage Island . . .	2	22	0	97	21	0
	Pulo Nias, N.W. Pt.	1	36	0	96	55	0
	— South East Point .	0	38	0	97	42	0
	Pulo Lacotta . . .	1	44	0	98	0	0
	Claps Island . . .	0	4	0	97	36	0
		South					
	Pulo Mintao, N. end	0	1	0	98	6	0
	— South end . . .	0	41	0	98	10	0
	Se Booro, N. Point .	0	56	0	98	30	0
	— South Point . .	1	47	0	99	6	0
	Se Pora, N. end . .	2	0	0	99	44	0
	— Point Marlborough	2	25	0	99	56	0
	North Poggy, N. Point	2	32	0	100	0	0
	-- South West Point	2	52	0	99	57	0
	South Poggy, N. Pt.	2	50	0	100	14	0
	— South Point . .	3	20	0	100	34	0
	Trieste Island . . .	4	3	0	101	22	0
	Engano I., N. Point .	5	15	0	102	25	0
	— South Point . .	5	30	50	102	29	15
	— S. E. Point . . .	5	30	15	102	38	15
	Flat Point	6	0	0	104	40	0
	Little Fortune Island	5	56	0	104	32	0
	Bencoonat	5	35	0	104	17	0
	Crooe	5	15	0	104	2	0
	Pulo Pisang . . .	5	12	0	103	53	30
	Cawoor	4	56	0	103	36	0
	Manna Point . . .	4	33	0	103	8	0
	Buffalo Point . . .	3	58	0	102	29	0
Western Coast of Sumatra.	BENCOOLEN,						
	— Fort Marlborough	3	48	0	102	28	0
	Moco-moco	2	35	0	101	21	0
	Indrapour Point . .	2	12	0	100	52	0
	Pulo Marra	1	12	0	100	10	0
	Padang Head . . .	0	56	0	100	12	0
	Priaman	0	40	0	100	6	0
	Massang Point . .	0	17	0	99	41	0
		North					
	Mount Ophir . . .	0	4	58	100	0	15
	Ayer Bongy . . .	0	11	42	99	21	15
	Natal.	0	33	26	99	1	45
	Tappanooly Bay . .	1	40	0	98	55	0
	Var. 1° 18′ *E.*						
	Sinkel River . . .	2	13	0	97	39	0
	Bancoongong . . .	2	52	0	97	18	0
	Soosoo, Town . . .	3	41	0	96	36	0
	Cape Felix	3	43	0	96	20	0
	Analaboo	4	8	32	96	0	0
	Acheen Head . . .	5	36	0	95	21	0
	ACHEEN	5	35	0	95	26	0
	Golden Mountain . .	5	27	0	95	49	0
	Pedir, Village . . .	5	22	30	96	15	0
	Pedir Point . . .	5	29	0	96	10	0
	Toolo Samwer Point .	5	13	0	97	14	0

LATITUDES AND LONGITUDES.

(55) Places.	Lat. N.			Lon. E.		
	°	′	″	°	′	″
Eastern Coast of Sumatra.						
Diamond Point	5	17	0	97	33	0
Prauhilah Point	4	53	0	97	55	0
Quala Bubon	4	1	0	98	29	0
Delhi River	3	46	30	98	42	30
Battoo Barra River	3	13	15	99	37	0
Assarhan River	3	1	30	99	52	0
Reccan River,						
— Pulo Lalang Besar	2	10	0	100	37	0
Pulo Roupat, N. Pt.	2	6	0	101	42	0
Pulo Bucalisse,						
— Tanjong Jatta	1	36	0	102	0	0
Siak River, entr.	1	13	0	102	10	0
Campou River, entr.	0	35	0	103	8	0
Tanjong Barroo	0	1	0	103	49	0
	South					
Tanjong Bassoo	0	20	0	103	48	0
Tanjong Bon	0	59	30	104	24	0
P. Varela or Barallah	0	50	0	104	28	0
Batacarang Point	2	0	0	104	53	0
Third Point	2	23	0	105	32	0
Second Point	2	41	0	105	45	0
First Point	3	0	0	105	58	0
Lucepara Point	3	15	0	106	0	0
Hog Point	5	54	0	105	43	30
—						
	North					
Strait of Malacca.						
Pulo Bouton Dome	6	33	0	99	20	30
Pulo Pera	5	42	0	99	1	0
Pulo Pinang or						
Pr. of Wales' Island,						
— Fort Cornwallis	5	25	0	100	21	30
Pulo Dinding	4	16	0	100	38	0
Sambelang Is., S. end	4	3	0	100	35	0
Pulo Jarra	4	0	0	100	12	0
Pulo Varela	3	47	0	99	33	0
Brothers,						
— Pulo Pandan	3	24	0	99	49	0
Round Arroa	2	49	0	100	40	0
Long Arroa	2	52	30	100	35	0
North Bank, N.W. end	3	16	0	100	50	0
2¼ Fathoms Bank	2	53	0	101	3	0
Strait of Singapore.						
Little Carimon, N. end	1	8	30	103	25	0
Tree Island	1	7	30	103	36	0
Barn Island	1	9	0	103	41	0
Aligator I., N. end	1	10	30	103	40	0
St. John's I., S. Pt.	1	13	0	103	51	30
Bintang Hill	1	5	0	104	29	0
Pedro Branco	1	20	0	104	25	30
Pulo Panjang, W. Pt.	1	2	0	104	47	0
Ragged Island	0	56	30	104	56	30
Geldria's Shoal	0	48	0	104	59	0
Strait of Dryon,						
— Red Island	0	50	50	103	38	15
Var. 1° 56′ *E.*						
— South Brother	0	34	0	103	48	0
	South					
Calantiga Island	0	29	0	104	5	0
Pulo Varella or						
Barallah	0	50	0	104	28	0
Lingen Island, E. Pt.	0	18	0	105	4	0
Ilchester's Shoal	0	28	0	105	3	0
Pulo Taya	0	45	30	104	58	0

(56) Places.	Lat. S.			Lon. E.		
	°	′	″	°	′	″
Pulo Toty	0	58	0	105	42	0
The Seven Islands	1	8	0	105	24	0
Frederick Henry Rock	1	55	30	105	2	30
Banka Island,						
— Monopin Hill	2	0	0	105	14	0
— Point Lallary	2	49	0	105	55	0
— Entrance Point	3	2	0	106	54	0
— Brekat Point	2	35	0	106	52	0
— Tanjong Riah	1	55	0	106	14	0
— Tanjong Muncooda	1	28	30	105	57	0
— Goonong Marass,						
Peak	1	53	0	105	52	0
— Tanjong Goonting	1	43	0	105	21	0
Lucepara Island	3	13	0	106	10	0
Fairlee Rock	3	27	0	107	1	0
Pulo Leat, center	2	52	0	107	3	0
Alceste Rock	2	46	0	107	3	0
Discovery Rock	2	52	0	106	56	0
Gaspar Island	2	25	30	107	6	0
Canning's Rock	2	23	0	107	14	0
Vansittart's Shoal,						
— South end	3	11	0	107	7	0
Billiton I., S. E. Pt.	3	22	0	108	12	0
— S. W. Point	3	18	0	107	30	0
— N. E. Point	2	40	0	108	20	0
West Island	2	30	0	107	36	0
Shoe Island	3	47	30	108	2	0
Discovery's W. Bank	3	39	0	108	43	0
Discovery's Reef	3	36	30	108	48	30
Discovery's E. Bank	3	32	40	109	9	43
Fox's Bank	3	32	0	110	4	0
Osterly's Shoal	3	19	0	108	40	30
Scharvogel's Is., S. end	3	22	0	108	26	0
Cirencester's Bank	3	17	0	109	4	54
Cirencester's Shoal	2	54	30	108	58	30
Montarin Islands,						
— Toekoekemou I.	2	30	45	108	36	30
— East Island	2	30	45	108	51	45
Ontario's Reef	2	1	15	108	39	15
Souroutou, W. end	1	42	0	108	41	30
Caremata, Peak	1	36	30	108	54	30
— N. W. end	1	33	0	108	49	0
Greig's Shoal, mid.	0	55	0	108	37	0
	North					
Entrance to the China Sea.						
St. Barbe	0	7	0	107	15	0
Direction Island	0	15	0	108	5	0
Pulo Dattoo	0	7	0	108	36	0
St. Esprit Is., E. end	0	34	0	107	13	30
Welstead's Rock	0	32	0	107	55	0
St. Julian's Island	0	54	0	106	48	0
Tumbelan Is., E. end	1	0	0	107	35	0
Europe's Shoal	1	12	0	107	24	0
Victory's Island	1	34	0	106	22	0
Acasta Rock	1	39	0	106	21	0
Pulo Tingy	2	17	0	104	11	0
Pulo Aor	2	29	30	104	34	30
Pulo Pisang	2	37	0	104	23	0
Pulo Timoan, N. Pt.	2	54	0	104	15	0
— South Point	2	44	0	104	15	0
Pulo Varella	3	16	0	103	48	0
Pulo Domar	2	45	0	105	23	0
White Rock	2	18	0	105	33	0

LATITUDES AND LONGITUDES.

	(57) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Saddle Island . . .	2	27	0	105	41	0
	South Anambas,						
	— Southern Island .	2	18	0	106	12	0
	Middle Anambas,						
	— West Island . .	3	9	0	105	37	0
	North Anambas,						
Entrance to the China Sea.	— N. E. end . . .	3	27	0	106	15	0
	Low or Separate I. .	3	1	0	107	48	0
	North Haycock Island	3	19	0	107	34	0
	Peaked Island . . .	3	54	0	107	53	0
	N. W. Island . . .	4	7	0	107	52	0
	Pyramidal Rock . .	4	8	0	107	27	0
	Saddle Island . . .	4	31	0	107	44	0
	North Natunas, N. end	4	49	0	108	2	0
	Great Natunas,						
	— East Point . . .	3	58	0	108	26	0
	— North Point . .	4	13	0	108	14	0
	South Natunas,						
	— Flat Island . . .	3	3	0	108	54	0
	— West Island . .	2	40	0	108	40	0
	— East Island . . .	2	40	0	109	26	0
	— South or High I. .	2	26	0	109	12	0
	South Haycock Island	2	13	0	108	57	0
	St. Pierre	1	56	0	108	53	0
	——	South					
	Prince's Island, Peak	6	35	0	105	15	0
	Crocatoa, Peak . .	6	8	30	105	25	30
	Pulo Besse	5	57	0	105	28	30
	Thwart the Way,						
Strait of Sunda	—N. E. Point . . .	5	55	30	105	51	0
	North Island . . .	5	41	0	105	49	0
	Three Sisters . . .	5	44	0	105	48	0
	Button	5	53	0	105	55	0
	Cap	5	59	40	105	55	0
	Pulo Baby, W. end .	5	48	0	106	14	0
	South Watcher . .	5	41	30	106	43	0
	North Watcher . .	5	12	30	106	32	0
	Armuyden Bank . .	5	13	30	106	48	0
	Brothers, N. end . .	5	9	30	106	5	0
	Brouwers Shoals . .	5	5	0	106	15	0
	Bumkin Island . .	5	47	0	108	23	0
	Pulo Rackit . . .	5	56	0	108	22	0
Java Sea.	Carimon Java Islands,						
	— Peak	5	50	0	110	34	0
	Lubec Island, mid. .	5	49	0	112	48	0
	Arrogant Shoal . .	5	12	0	113	0	0
	Great Solombo, Hill .	5	33	0	114	28	0
	Little Solombo . .	5	21	0	114	28	0
	Arentes Island . .	5	10	0	114	36	0
	——						
	Java Head	6	48	0	105	11	0
North Side of Java.	First Point	6	44	0	105	10	0
	Mew I., E. Point .	6	43	0	105	17	0
	Second Point . . .	6	36	0	105	24	0
	Third Point . . .	6	27	0	105	39	0
	Anger, Town . . .	6	3	30	105	55	0
	Bantam, or						
	St. Nicholas Point .	5	52	0	106	2	0
	Bantam, Town . .	6	2	0	106	9	0
	BATAVIA, Obs. . . .	6	9	0	106	51	45
	Edam Island . . .	5	57	0	106	53	30
	Carawang Point . .	6	1	0	107	3	0

	(58) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Sedary Point . . .	5	59	0	107	27	0
	Pamanoekan Point .	6	11	0	107	49	0
	Indramay Point . .	6	15	0	108	20	0
North Side of Java.	Cheribon, Town . .	6	47	0	108	36	30
	— Mount	6	56	0	108	26	0
	Taggal	6	50	0	109	14	0
	— Mount	7	22	0	109	19	0
	Samarang	6	57	0	110	25	0
	Mandalique Island .	6	22	0	110	54	0
	Rembang	6	42	0	111	19	0
	Lassem, Hill . . .	6	41	0	111	28	0
	Lerang Point . . .	6	35	0	111	27	30
	Panka Point . . .	6	52	0	112	34	30
	Sourabaya	7	15	30	112	48	0
	Cape Sedano, E. Pt. .	7	49	0	114	24	0
	Utrich, Fort . . .	8	16	0	114	17	0
	Balambouang Bay .	8	23	0	114	18	0
	South East Point . .	8	46	0	114	34	0
South Side of Java	Nusa Baron Island .	8	37	0	113	23	0
	Segara Wedi Bay .	8	25	0	111	43	30
	Patchican Bay . .	8	17	0	111	1	0
	Nusa Cambangan I.,						
	— South West Point	7	51	0	108	46	0
	Chilantaran Point .	7	46	0	107	40	0
	Wine Cooper's Point	7	27	0	106	28	0
	Palambang Point . .	6	59	0	105	16	0
	——						
	Madura Island,						
	— N. W. Point . .	6	53	0	112	45	30
	— N. E. Point . .	6	53	0	113	58	30
	Pondy Island . . .	7	1	0	114	4	0
	Four Brothers . . .	7	8	0	115	0	0
	Urk Island	7	15	0	115	13	0
	Kangelang Island,						
	— North end . . .	6	53	0	115	17	30
	— South end . . .	7	9	0	115	25	30
	Antelope's Is., mid. .	7	11	0	115	50	9
Eastern Passages to China.	Hasting's Island . .	6	56	0	116	24	0
	Bally Island, Peak .	8	24	0	115	24	0
	— S. or Table Point .	8	50	0	115	10	0
	Var. 1° 12′ *E.*						
	— N. E. Point . .	8	18	0	115	35	0
	Bally Strait, N. ent. .	8	6	0	114	22	0
	Lombock Island,						
	— Isles off N. W. Pt.	8	13	0	115	59	0
	— Peak	8	21	30	116	26	0
	— Bally, Town . .	8	42	30	116	33	0
	— Peejou Village .	8	48	0	116	28	0
	Sumbaya Island,						
	— Alass	8	44	0	116	48	0
	— Isles off N. W. Pt.	8	21	0	116	57	0
	— Sumbawa, Town .	8	27	0	117	24	0
	— Tumbora Mount .	8	9	0	117	43	0
	— Rocky Point . .	8	8	0	118	36	0
	— Rugged Point. .	8	11	0	118	51	0
	— Sapy, Town . .	8	34	0	119	2	0
	Gooning Apée, Peak	8	11	0	119	5	0
	Comodo I., N. E. Pt.	8	22	0	119	37	30
	Flores I., S. W. Pt. .	8	50	0	119	45	0
	— Iron Cape, N.E.Pt.	8	5	0	122	52	0
	Flores Strait, S. entr.	8	40	0	122	58	0
	Solor Island, Fort . .	8	27	0	123	22	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(59) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Pulo Comba . . .	7	49	0	123	41	0
	Lomblen I., Peak . .	8	12	0	123	52	0
	— East Point . . .	8	14	0	124	0	0
	Pulo Pantar, N.E. Pt.	8	10	0	124	25	0
	PuloOmbaye, N.W.Pt	8	9	0	124	27	0
	— East Point . . .	8	17	0	125	15	0
	Sandalwood I., W. Pt.	9	42	0	119	1	45
	— South Point . .	10	22	0	120	20	0
	— East Point . . .	10	0	0	120	45	0
	— Baring's Bay . .	9	37	0	120	16	0
	— North West Point	9	18	0	119	13	0
	Savu Island, mid. . .	10	37	0	122	0	0
	New Island	10	46	0	121	13	0
	Rottee I., S.W. Point	11	2	0	122	55	0
	— Booca Bay . . .	10	56	0	123	10	0
	Cartier's Island . .	12	29	0	123	56	0
	Heywood's N. Reef .	12	48	0	124	25	0
	— South Reef . . .	13	29	0	124	5	0
	Hibernia Shoal . .	11	56	0	123	28	0
Eastern Passages to China.	Ashmore's Shoal,						
	— North East end .	12	11	0	122	58	30
	Scott's Reef, N.W.end	13	52	30	121	59	0
	Rowley's Shoals,						
	— Imperieuse, E. end	17	35	0	118	51	0
	— Clerke's, S. end .	17	28	0	119	18	0
	— Mermaid's . . .	17	12	0	119	35	0
	Ritchie's Reef . . .	20	17	40	114	46	6
	Timor I., S. W. Point	10	23	0	123	30	0
	— Copang, Fort . .	10	8	30	123	35	0
	Var. 0° 37′ E.						
	— North West Point	9	24	0	123	55	0
	— Batagoda . . .	8	57	30	124	55	0
	— Delli	8	35	30	125	40	0
	— East Point . . .	8	31	0	127	19	0
	Pulo Jackee . . .	8	32	0	127	32	0
	Pulo Battoo . . .	9	16	0	124	5	0
	Pulo Cambing, N. Pt.	8	21	0	125	3	0
	Pulo Babye, S. Pt. .	8	20	0	125	45	0
	Dog Island	7	41	0	126	3	0
	Wetter I., N. E. Point	7	36	0	126	34	0
	Kisse Island, W. Bay	8	14	0	127	8	0
	Roma, I. Madap . .	7	38	0	127	25	0
	Pulo Damma. Bay .	7	4	0	128	47	0
	Serwatty Islands,						
	— Lettee I., Bay . .	8	18	0	127	49	0
	— Ceremata, S.E. Pt.	8	25	0	129	35	0
	Cerowa, S. E. Pt. . .	6	28	0	130	41	0
	Babber I., Tepa . .	7	52	0	129	58	0
	Timor Laut, S. Point	8	17	0	131	7	0
	Arroe Is., S. end . .	7	6	0	134	20	0
Banda Sea.	Banda Islands . .	4	31	0	130	0	0
	Turtle Is., E. end . .	5	25	0	127	38	0
	Lucepara Islands . .	5	40	0	127	21	0
	Goonong Apy or						
	Burning Island . .	6	35	0	126	40	0
	Bouro I., N.W. Point	3	6	0	125	57	0
	— CajeliBay, N.E.Pt.	3	15	0	127	5	0
	— Fort	3	24	0	127	4	0
	Amblaw Island . . .	3	52	0	127	14	0
	Pulo Manipa, mid. .	3	17	0	127	28	0
	Bonoa Island . . .	3	0	0	127	56	0

	(60) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Amboyna Island,						
	— Fort Victoria . .	3	40	0	128	15	0
	Noesa Laut	3	40	0	128	52	30
	Ceram I., S.W. Point	3	31	0	127	56	0
	— Sawa Bay . . .	2	51	0	129	6	0
	— Flat Point . . .	2	53	0	129	42	30
	— Waroo Bay . . .	3	25	0	130	40	0
	Kessing I., E. Point .	3	50	0	131	10	0
	Ceram Laut, E. end	3	55	0	131	19	0
	Goram Island . . .	4	0	0	131	44	0
	Mattabella Islands .	4	21	0	132	5	0
	Leeuwaarden Island .	3	20	0	130	58	0
	Leeuwaarden Shoal .	2	56	0	130	43	30
	Xulla Islands,						
	— Albion Island . .	1	40	0	124	26	0
	— Skelton's Island .	1	40	0	124	36	0
	— Xulla Talaybo,						
	S.W. end	1	55	0	124	40	0
	— Xulla Mangola,						
	S. E. end	1	46	0	126	17	0
	— Lissamatula,						
	S. E. Point . . .	1	46	0	126	32	0
	— Xulla Bessey,						
	N.W. Point . . .	1	58	0	125	48	0
	South East Point .	2	28	0	125	58	0
Pitts Passage.	Gomona Island . .	1	56	0	127	38	0
	Oby Major, W. end .	1	32	0	127	12	0
	Lookisong, S. end . .	1	45	0	128	10	0
	Pulo Gasses, S. Point	1	41	0	128	20	0
	Kekik Island . . .	1	33	0	128	37	30
	Pulo Pisang . . .	1	23	0	128	53	0
	Boo Islands	1	12	0	129	18	0
	Grand Kanary . . .	1	44	0	129	40	0
	Mysole, W. end . .	1	54	0	129	46	0
	Pulo Popa, S.E. Point	1	12	0	129	52	0
	PuloBattanta, C.Mabo	0	56	0	130	25	0
	Salawatty I., W. end	1	2	0	130	46	0
	Pigeon Island . . .	0	37	0	130	51	0
	Augusta Island . .	0	36	0	130	48	0
	K. William's I., W.end	0	28	0	130	44	0
	Amsterdam I. . . .	0	19	30	132	15	0
	Waygeou I., S.W. Pt.	0	16	0	130	19	0
	— Point Pigot . .	0	21	0	131	18	0
	— Foul Island . . .	0	43	0	131	0	0
	— Offak, Harbour .	0	0	0	130	50	0
	Gagy Island . . .	0	25	0	130	0	0
		North					
	Geby, I., N.W. Point	0	4	0	129	19	0
	Syang Island . . .	0	22	0	129	55	0
	Eye Island	0	24	0	129	53	0
	Ormsbee's Shoal . .	0	42	0	130	4	0
	Youl or Aiou Islands,						
	— Aiou Baba . . .	0	25	0	131	0	0
	— N.W. Island . .	0	38	0	131	8	0
	— N. end of Shoal .	0	41	0	131	6	0
	— N. E. Island . .	0	36	0	131	15	0
	Asia's Is., S. end . .	1	0	0	131	17	0
		South					
	Gillolo I., S. end . .	0	48	0	128	28	0
	— Point Samolin . .	0	11	0	127	45	0
		North					
	— North Point . .	2	23	0	127	45	30

TABLE LVI.

LATITUDES AND LONGITUDES.

	(61) Places.	Lat. N.			Lon. E.		
		°		′	°	′	″
	Gillolo I., Ossa . .	0	45	0	128	22	0
	Pulo Moar	0	9	0	128	58	0
	Canton's Shoal . . .	0	35	0	128	55	0
	Catharine's Islands .	0	39	0	129	11	0
	Aurora Shoal . . .	0	40	0	129	30	0
	Ardasier's Rock . .	0	45	0	129	8	0
	Morty Island, N. end	2	44	0	128	25	0
Molucca Islands.	— South end . . .	1	48	0	128	26	0
	Ternate Island, Road	0	49	0	127	30	0
	Tidore I, N. E. end	0	46	0	127	34	30
	— South end . . .	0	34	0	127	24	30
	Kayo Island, N. end .	0	7	0	127	23	30
	The Wolf	0	30	0	127	6	0
		South					
	Amsterdam Island .	0	20	30	127	53	30
	Batchian Island,						
	— Heneker Point . .	0	48	0	128	3	0
	— Fort Barnevelt .	0	32	0	127	44	0
		North					
	Tyfore Island . . .	0	58	0	126	27	0
	Meyo Island . . .	1	12	0	126	39	0
	Meangis Islands . .	5	0	0	127	45	0
	Salibaboo Islands,						
	— Karkalang, N. Pt.	4	27	0	127	6	0
	South Point . . .	4	0	0	127	5	0
	— Kabroang, S. end .	3	47	0	127	11	0
	Northumberland Sh. .	3	39	0	127	14	0
	Sangir I., N. Point .	3	46	0	125	41	0
	— River	3	28	0	125	44	0
	— South East Point .	3	21	0	125	48	0
	Siao Island	2	43	0	125	35	30
	Tagolanda Island . .	2	23	0	125	36	0
	Bejaren Island . . .	2	6	0	125	30	0
	Banka Island . . .	1	52	0	125	24	0
	———						
	Monado, Fort . . .	1	28	0	124	48	0
	Cape Coffin	1	44	0	125	22	0
	Kemar	1	22	0	125	19	0
	Goonoong Tella River	0	28	30	123	15	0
		South					
Celebes Island.	Cape Talabo . . .	0	48	0	123	51	0
	Point Lassoa . . .	5	34	0	120	28	0
	Laycan Point . . .	5	37	0	119	33	30
	MACASSAR, Castle . .	5	9	0	119	36	0
	Cape Mandhar . . .	3	35	0	119	9	0
	Cape William . . .	2	34	0	118	58	0
		North					
	CapeTemoel, N.W.Pt.	0	1	0	119	26	0
	North Watcher . .	0	33	0	119	34	0
	Point Donda . . .	0	48	0	119	57	0
	Cape Rivers . . .	1	15	0	120	34	0
	———	South					
	Waxway Island . .	3	34	0	123	14	0
	Weycoongy I., mid. .	4	3	0	123	8	0
	Bouton I., N.E. Pt. .	4	23	0	123	4	0
	— Calansoesoe Bay .	4	55	0	123	11	0
	— East Point . . .	5	15	0	123	15	0
	— South Point . .	5	42	0	122	44	0
	— Bouton, Town . .	5	27	0	122	40	0
	Cambyna, Peak .	5	21	0	121	57	0
	South Island . . .	5	40	0	122	30	0
	Hagedis Island . .	6	13	0	122	40	0

	(62) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Token Besseys Is.,						
	— Wangiwange,						
	North end . . .	5	15	30	123	33	0
	— Pirocko, S. end .	6	14	0	124	1	0
	St. Matthew's Is. mid	5	18	0	124	16	0
	Velthoen's Island . .	5	58	0	124	48	0
	Angelica Shoal . .	7	40	0	122	18	0
	Rusa Linguete . .	8	5	0	122	0	0
	Rusa Raji	8	17	0	121	38	0
	Bangalore Shoal . .	7	40	0	121	46	0
	Kalatoa Island . . .	7	12	0	121	43	0
	S. E. Schiedam . .	7	12	0	120	56	0
	N. W. Schiedam . .	7	1	0	120	28	0
	Salayer I., S. Point .	6	24	0	120	35	0
	— North Point . .	5	49	0	120	30	0
	South Island . . .	5	46	0	120	29	0
	Middle Island . . .	5	40	0	120	28	0
	North Island . . .	5	37	0	120	24	0
	Mansfield Shoal . .	5	45	0	120	13	30
Celebesian Archipelago.	The Brill, S. end . .	6	5	0	119	0	0
	Tanataki Island . .	5	34	0	119	24	0
	Tonyn Is., S. W. end	5	31	0	118	36	0
	De Laars or Boot,						
	— South East end .	5	53	0	118	26	0
	Zalinoff Island . . .	5	31	0	118	25	0
	Hen and Chickens .	5	28	0	117	54	0
	Amsterdam Island .	5	15	0	117	54	0
	Rotterdam Island . .	5	10	0	117	56	0
	Middleburg Island .	5	5	0	117	57	0
	Sibbald's Bank . .	5	46	0	117	15	0
	Noesa Comba . . .	5	15	0	117	9	0
	Noesa Seros . . .	5	2	0	117	9	0
	Little Pulo Laut Is.,						
	— South end . . .	5	0	0	115	47	0
	Moresses	4	25	0	116	3	0
	Dwalder	4	12	0	116	21	0
	Royal George Shoal .	4	17	30	116	34	0
	Two Brothers . . .	4	26	0	116	32	0
	Waller's Shoal, S. end	4	37	0	117	7	0
	Laurel Shoal . . .	4	32	0	117	15	0
	Pulo Laut, S. Point .	4	4	0	116	22	0
Strait of Macassar.	— North East Point .	3	23	0	116	41	0
	— North Point . .	3	13	0	116	30	0
	Three Alike . . .	3	41	0	116	54	0
	Dutch Triangles . .	3	1	0	117	53	0
	Addington's Shoal .	2	50	0	117	0	0
	Little Paternosters,						
	— South Island . .	2	50	0	117	40	0
	— North East Island	2	10	0	117	58	0
	— North West Island	2	8	0	117	42	0
		North					
	North Watcher . .	0	33	0	119	34	0
	———						
	North Point . . .	7	3	0	116	43	0
Island of Borneo.	Sandakan Bay,						
	— Babalatoli Island .	5	54	0	118	6	0
	Unsang Point . . .	5	19	0	119	0	0
	Kaneeoongan Point .	1	5	0	119	10	0
		South					
	Dondrekin I., S. Pt.	0	54	0	117	36	0
	Passeer River, entr. .	1	54	0	116	34	0
	Ragged Point . . .	2	10	0	116	48	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(63) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Shoal Point	2	35	0	116	47	0
	Point Salatan . . .	4	10	0	114	42	0
	Benjar River, entr.	3	25	0	114	38	0
	Flat Point	3	31	0	112	8	0
	Pulo Mancap . . .	3	4	45	110	11	30
	Mancap Shoals, S. end	3	22	0	110	8	0
Island of Borneo	Rendezvous I., W. end	2	44	0	110	3	0
	Minto Hill	2	15	0	110	6	0
	Succadana	1	16	0	109	58	0
		North					
	Pontiana River, entr.	0	2	0	109	12	0
	Marapava Point . .	0	17	30	109	0	0
	Sambas River, entr. .	1	13	30	109	3	0
	Tanjong Apee . . .	1	57	0	109	14	0
	Tanjong Dattoo . .	3	0	0	110	46	0
	BORNEO	4	55	0	114	55	0
	Pulo Tiega	5	38	0	115	16	0
	Ahai	6	21	0	116	24	0
	Keeney Balloo, Mount	6	3	0	116	40	0
	—						
	Banguey, Peak . . .	7	19	0	117	6	0
	Balambangan Island,						
	— North Harbour .	7	16	0	116	58	0
	Mangsee Islands . .	7	32	0	117	19	0
	Balabac, Peak . . .	7	59	0	117	2	0
	St. Michael's Bank,						
	— North end . . .	7	50	0	118	20	0
	Cagayan Sooloo . .	7	0	0	118	36	0
	Palawan, S.W. Point	8	24	0	117	14	0
	— Long Point . . .	9	39	0	118	21	45
	— Ooloogan Point .	10	12	0	118	55	0
	— North Point . .	11	30	0	119	37	0
	Ragged Islands . .	11	15	0	119	21	0
	York Breakers . . .	9	54	0	118	12	0
	Paraquas	9	10	0	117	32	0
	—						
	Sooloo, Town . . .	6	1	0	121	12	0
Sooloo Islands.	Pangootaran . . .	6	15	0	120	40	0
	Belawn, E. Point . .	6	0	0	122	8	0
	Tapeantana, S. E. Pt.	6	14	30	122	8	0
	Tamook	6	28	0	121	56	0
	Mataha	6	32	0	121	50	0
	Sangboye	6	48	30	121	35	0
	Teynga	6	52	0	121	43	0
	Ballook, N. end . .	6	40	0	121	50	0
	Basseelan, E. Point .	6	30	0	122	30	0
	—						
	Mindanao Island,						
	— Samboangan . .	6	43	0	122	14	0
	— Port St. Maria .	7	36	0	122	16	0
	— Balangonan Point .	7	51	0	122	21	0
Philippine Islands	— North Point . .	9	48	0	125	20	0
	— Surigao, Village .	9	47	0	125	25	0
	— Cape St. Augustine	6	4	0	126	48	0
	— South Point . .	5	39	0	125	7	0
	— Mindanao, Town .	7	10	0	124	35	0
	Sarangani I., S. Point	5	20	0	125	43	0
	Hummock I., Peak .	5	22	0	125	32	0
	Samar Island,						
	— C. St. Espirito Santo	12	40	0	125	38	0
	St. Bernardino Island	12	46	0	124	16	0
	Cagayanes Is., mid .	9	31	0	121	23	30

	(64) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Negros Island,						
	— Point Sojoton . .	9	50	0	122	24	0
	Panay Island,						
	— Point Nasog . .	10	25	0	122	6	0
	— Astoman	10	32	0	122	4	0
	— Point Potol . . .	11	48	0	122	0	0
	White Rock . . .	10	28	0	121	15	0
	Sombrero Rock . .	10	45	0	121	38	0
	Cuyo Island . . .	10	52	0	121	16	0
	Dry Bank	11	24	30	121	54	0
	Quimluban Islands,						
	— North End . . .	11	28	0	121	11	0
	Caravaos	11	53	0	121	48	0
	Green Island . . .	12	3	0	119	49	15
	Calamianes, Rock .	11	56	15	119	51	30
	N.W. Rock	12	23	15	119	54	45
	North Rock . . .	12	27	0	120	4	15
	Calavite	12	21	0	119	56	30
	Appo Shoal, N. end .	12	45	0	120	31	0
Philippine Islands.	— Great Island . .	12	39	0	120	28	0
	Ambolon, S. end . .	12	9	0	121	15	0
	Mindoro Island,						
	— Pandan Point . .	12	48	0	120	52	0
	— River Musi . .	13	14	0	120	44	0
	— Point Tubili .	13	20	0	120	34	0
	— Point Calavite . .	13	27	0	120	20	0
	Luban Island, mid. .	13	44	0	120	16	0
	Goat Island	13	51	0	120	7	0
	Luconia or Luzon I.,						
	— Cavite	14	29	0	121	0	0
	— Manilla, City . .	14	36	0	121	2	30
	Var. 0° 17′ *E.*						
	— Subic Bay, entr. .	14	46	0	120	16	0
	— Silanguin Bay . .	14	47	0	120	7	0
	— Point Capones . .	14	52	30	120	3	30
	— Sisters	15	50	0	119	50	0
	— Adder's Island . .	15	55	0	119	49	0
	— Point Bolinao . .	16	26	0	119	52	0
	— Cape Bajadore . .	18	32	0	120	39	0
	— Cape Engano . .	18	39	0	122	16	0
	— Cape St. Ildifonso	15	47	0	122	7	0
	— Sorsogan . . .	12	52	20	123	50	0
	Ticoa Island,						
	— Port St. Jacinto .	12	34	0	123	42	0
	Catanduanes Island,						
	— North Point . .	14	16	0	121	20	0
	— South Point . .	13	38	0	124	16	0
	—						
	Babuyan Islands,						
	— Camaguin . . .	19	4	0	121	52	0
	— Fuga	19	1	0	121	21	0
	— Lapurip	19	15	0	121	12	0
	— Calayan	19	28	0	121	25	0
	— Claro Babuyan .	19	37	0	121	54	0
	Bashee Islands,						
	— Balintang . . .	19	58	0	122	14	0
	— Batan, Mount . .	20	23	30	122	11	0
	— Grafton	20	34	30	122	4	0
	— North Bashee . .	21	9	0	122	0	0
	Gadd's Reef . . .	21	43	0	121	41	0
	Botel Tobago Xima .	21	59	0	121	38	0
	Little Botel . . .	21	56	30	121	41	0

LATITUDES AND LONGITUDES.

(65) Places.	Lat. N.			Lon. E.		
	°	′	″	°	′	″
Vele Rete Rocks .	21	42	0	120	52	0
Formosa I., S. Point .	21	54	0	120	55	0
— Lamay Island . .	22	19	15	120	27	0
— North Point . .	25	18	0	121	34	0
— N.W. Point . .	25	11	0	121	6	0
— N.E. Point . . .	25	11	0	121	56	0

XVIII. Islands, Rocks, and Shoals, in the CHINA SEA.

* For the Islands, &c. at the entrance to the China Sea, see Columns (56) and (57).

Pulo Brala	4	47	0	103	37	0
Pulo Capas	5	15	0	103	14	0
Great Redang Island	5	53	0	102	55	0
Pulo Cara	8	29	0	100	56	0
Pulo Way	9	55	0	103	25	0
Pulo Oby	8	25	0	104	54	0
Brothers	8	35	0	106	8	0
Pulo Condore, mid. .	8	40	0	106	42	0
Pulo Sapata	10	0	0	109	2	30
Great Catwick . . .	10	6	0	108	52	0
Royal Bishop's Shoal,						
— South end . . .	9	40	0	108	21	30
Charlotte's Shoal . .	7	11	0	107	36	0
Pulo Ceicer de Mer .	10	32	30	108	53	0
Holland's Bank, S. end	10	37	15	108	40	0
Britto's Bank . . .	10	30	42	107	49	0
Minerva's Bank . .	10	38	0	110	18	0
Prince of Wales' Bank,						
— South West end .	8	3	0	110	24	0
— North East end .	8	13	0	110	34	0
West London Reef .	8	55	0	112	0	0
East London Reef .	8	48	0	112	24	0
Dhaulle's Shoal . .	9	32	0	112	25	0
Stags, North end . .	8	24	0	112	57	0
Amboina Shoal . . .	7	52	20	112	56	0
Swallow Shoal . . .	7	23	30	113	52	0
Royal Charlotte Shoal	6	56	30	113	37	30
Louisa's Shoal . . .	6	20	0	113	18	0
Friendship's Sh. N. end	6	0	0	112	49	0
Sea Horse Breakers .	5	35	0	112	28	0
Investigator's N.W. Sh	9	40	0	113	4	0
Western Reef . . .	10	15	0	113	41	0
Great Reef., N. end .	10	7	0	113	52	0
South Island . . .	10	45	0	114	27	0
North West Island .	11	9	0	114	18	0
North Danger . . .	11	29	0	114	20	0
Investigator's Shoal,						
— West end . . .	8	5	0	114	35	0
— East End . . .	8	10	0	114	51	0
Viper's Shoal . . .	8	0	0	115	25	0
Half Moon Shoal, S. end	8	54	30	116	15	30
Royal Captain's Shoal	9	2	24	116	42	45
Bombay's Shoal . .	9	27	0	116	55	0
Investigator's N.E Sh.	9	13	0	116	30	0
Sea Horse Bank . .	10	51	0	117	55	30
Scarborough Shoal, mid	15	8	0	117	48	30
Macclesfield's Bank,						
— North end . . .	16	19	0	114	36	0

(66) Places.	Lat. N.			Lon. E.		
	°	′	″	°	′	″
— South end . . .	15	17	0	114	10	0
St. Esprit's Shoal . .	19	30	0	113	6	0
Pratas, N. E. end . .	20	47	0	116	53	45
— N.W. end . . .	20	45	0	116	42	15
North Shoal, W. end	17	4	30	111	27	0
— East end . . .	17	6	10	111	32	30
Amphitrite, W. end .	16	59	0	112	12	0
— East end . . .	16	54	0	112	23	0
Woody Island . . .	16	50	0	112	19	0
Rocky Island . . .	16	52	0	112	20	0
Lincoln Island . . .	16	41	0	112	42	0
Pyramid Rock . . .	16	35	15	112	37	30
Money's Island . .	16	28	0	111	29	30
Paracels. Robert's Island . .	16	31	50	111	31	30
Pattle's Island . . .	16	33	20	111	36	0
Observation Bank .	16	36	0	111	40	30
Drummond's Island .	16	29	10	111	13	37
Gov. Duncan's Island	16	28	40	111	41	0
Discovery's Shoal,						
— West end . . .	16	11	0	111	32	30
— East end . . .	16	16	0	111	46	30
Vadalore's Shoal,						
— West end . . .	16	17	30	111	58	30
— East end	16	19	30	112	4	45
Bombay Shoal . . .	16	0	0	112	26	0
Passoo Keah Island .	16	2	0	111	45	0
Triton Island . . .	15	46	40	111	11	30

XIX. The Coast and adjacent Islands from CANTON to CAPE NORTH.

CANTON, Factory . .	23	7	10	113	14	0
MACAO, Town . . .	22	10	30	113	32	0
Grand Ladrone . .	21	57	10	113	41	0
Po-toe	22	2	6	113	38	0
Chung Chow . . .	22	10	15	113	43	50
Laff-Sammee, Peak .	22	8	30	113	48	40
Lantao or Ty-ho,						
— S.W. Point . . .	22	12	0	113	50	0
— N. E. Point . . .	22	21	0	114	2	35
— Highest Peak . .	22	15	15	113	54	15
I-Chow	22	3	0	113	54	45
Asses Ears or Ky-poong	21	54	0	114	1	0
Grand Lema, N.E. end	22	4	45	114	18	30
Lin-ting	22	6	0	114	1	30
Hong-kong Island,						
— Tytam Bay, S.W. Pt.	22	12	30	114	12	40
Waylan Island . . .	22	11	44	114	17	50
Nine Pin Rock . .	22	16	30	114	22	0
Mirs Bay, S. E. Point	22	27	15	114	30	0
Chueng-Chow . . .	22	25	0	114	40	15
Toonee-Ang . . .	22	28	10	114	38	0
Mendoza Island . .	22	31	22	114	50	45
Fokay Point . . .	22	33	0	114	53	0
Pedro Branco . . .	22	19	30	115	7	45
Sha-long-low . . .	22	39	30	115	35	30
Teng-mee	22	45	0	115	50	0
Cup-chee-san . . .	22	49	30	116	7	30
Black Mount . . .	22	52	30	116	11	0
Breaker Point . . .	22	56	45	116	31	30

LATITUDES AND LONGITUDES.

	(67) Places.	Lat. N. °	′	″	Lon. E. °	′	″
	Cape of Good Hope	23	13	45	116	50	0
	Namoa Island, W. Pt.	23	28	0	116	59	30
	— N. E. Point . . .	23	32	0	117	13	0
	Lamock Islands, S.end	23	17	0	117	21	0
	Brothers	23	32	0	117	48	0
Eastern Coast of China.	Chapel Island . . .	24	11	0	118	20	0
	Amoy Harbour,						
	— Caw-chat Rock	24	20	30	118	16	30
	Chin-chew Bay, abt.	24	54	0	118	50	0
	Lam-yet Is., S. end .	24	59	15	119	34	30
	Ting-Hoy Harbour .	26	10	0	119	57	0
	Qui-san Is., S. E. end	29	22	0	122	11	54
	CHUSAN, Harb. about .	30	14	0	122	7	0
	Ningpo, City . . .	29	55	0	121	24	0
	Tchin-san Islands . .	30	30	0	122	55	0
	Yang-tse-kiang R.ent.	31	20	0	121	30	0
	NANKIN	32	4	40	118	47	18
	Whang-ho River, entr.	34	3	0	119	50	0
	Shan-tung Promontory						
	— East Point . . .	37	26	0	122	45	0
	— South Point . .	36	54	0	122	41	0
	C. Zue-oo-tow . . .	37	35	50	121	28	10
	Miatau Islands,						
	— Tchoosan . . .	38	0	45	121	1	0
	Keu-San Islands . .	38	8	0	120	41	45
	Pei-ho River, entr.	38	51	30	117	49	0
	PEKIN, obs.	39	54	13	116	26	0
	Gulf of Leotong,						
	— S. E. or Charlotte's						
	Point, about . . .	38	36	0	121	10	0
	Basil Hall's Islands,						
	— N.W. end . . .	37	58	0	124	44	30
	Clifford's Is., middle	36	44	0	125	50	0
	Corea, Basil's Cape .	36	7	0	126	42	24
	— S.W. Point . . .	34	20	0	126	45	0
	— Cape Providence .	34	24	0	127	14	0
	Windsor Castle I. .	34	40	0	126	6	0
	Thistle Island . . .	34	20	0	126	4	0
	Lyra Island	34	10	0	126	8	0
	High Peaked Island .	34	5	30	125	15	0
	Quelpart I., N. E. Pt.	33	30	0	127	9	0
	— South Point . .	33	11	0	126	28	30
	Tsus-sima I., N. Pt. .	34	40	30	129	29	30
	— South Point . .	34	6	30	129	15	0
	Colnet's Island . .	34	16	30	129	55	45
	Corea, Port Chusan .	35	2	0	129	15	30
Tartary.	— Cape Clonard . .	36	2	0	129	38	0
	— Sanpou	37	42	0	128	32	0
	White Rock . . .	40	36	0	129	17	30
	Dagelet I., N. E. Pt.	37	25	0	130	56	0
	Argonaut's Island . .	37	52	0	129	50	0
	Ternay Bay	45	10	32	137	1	15
	Suffren Bay	47	51	0	138	43	0
	Cape Lesseps . . .	49	30	0	140	34	0
	Castries Bay . . .	51	29	0	140	56	19
	Vanjuas Point . . .	52	5	0	141	32	0
	Romberg Cape . .	53	26	30	141	44	45
	Jonas I., Peak, about	56	25	30	143	16	0
Russia.	Ochotsk	59	20	10	143	12	30
	Yamskoi	60	46	0	154	30	0
	Bolcheretskoi . . .	52	54	30	156	50	15
	Cape Lopatka . . .	51	0	15	156	42	45

	(68) Places.	Lat N. °	′	″	Lon. E. °	′	″
	Petropaulski . . .	53	0	37	158	44	30
	Kamschatka . . .	56	15	0	162	0	0
Russia.					West		
	Tschukotskoi Ness .	64	14	30	173	31	0
	East Cape	66	5	30	169	44	0
	Cape North . . .	68	56	0	179	11	30
	——				East		
	Formosa I., S. E. Pt.	21	54	0	120	53	15
	— South West Point	21	53	30	120	42	30
	— Lamay Island . .	22	19	15	120	27	0
	— Fort Zeeland . .	23	3	0	120	22	0
	— North West Point	25	11	0	121	6	0
	— North Point . .	25	18	0	121	34	0
	— North East Point .	25	11	0	121	56	0
	Pescadores Islands,						
	— Pehoe Island .	23	32	0	119	33	0
	Vela Rete Rock . .	21	42	0	120	51	50
	Gadd's Reef . . .	21	43	0	121	41	0
	Botol Tobago Zima .	21	59	0	121	38	0
	Samo Sana	22	40	0	121	32	0
	Hoapinsu Island . .	25	44	0	123	32	0
	Tiaou-su Islands . .	25	55	0	123	20	0
	Madjicosemah Is.,						
	— Southermost .	24	6	0	123	52	0
	— Westernmost . .	24	17	0	123	45	0
	— Ty-pin-san Island	24	42	0	125	36	0
	Kumi Island . . .	24	25	0	123	5	0
	Great Loo-choo I.,						
	— North Point .	26	52	0	128	6	30
	— Napakiang Road .	26	13	39	127	38	30
	— South Point . .	26	5	0	127	33	0
	Sulphur Island . .	27	52	0	128	22	0
	Crown Island . . .	27	49	0	129	5	0
	Harbour Island . .	28	20	0	130	0	0
	Bungelow Island . .	28	38	0	129	56	0
	Pinnacle Is.,						
	— N.W. end . .	29	58	0	129	55	0
	——						
	Kiusiu Island,						
	— Cape Nomo . .	32	35	10	129	42	30
	— Nangasaki, City .	32	45	0	129	52	0
	— Ooumoura . . .	33	0	0	130	7	0
	— Cape Seurote . .	32	58	30	129	35	0
	— N. W. Point . .	33	42	0	129	45	0
Islands of Japan.	— Kokouro, Town .	33	53	0	131	17	0
	— North Point . .	34	5	0	130	54	0
	— North East Point .	33	54	0	131	52	0
	— Cape Boungo . .	33	18	0	132	6	0
	— Cape Tschirikoff .	32	14	0	131	42	0
	— Cape Cochrane .	31	51	0	131	27	0
	— Cape Danville . .	31	28	0	131	27	0
	— Cape Nagaeff . .	31	15	0	131	11	0
	— C. Tschilschagoff .	30	56	45	130	36	30
	— Horner's Peak .	31	9	30	130	28	0
	— Kago Simo, Town	31	34	0	130	34	0
	— Cape Tchesme . .	31	24	0	130	2	0
	— Cape Kagul . .	31	42	20	130	7	0
	Tanega-sima I, N.Pt.	30	42	30	131	0	0
	Jakuno-sima I. mid. .	30	23	0	130	30	0
	Volcano Island . .	30	43	0	130	16	40
	St. Clair Island . .	30	45	15	129	54	15
	Nadijda Rock . . .	31	42	0	129	35	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(69) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Meac-sima Islands,						
	— South West end .	31	35	0	129	40	0
	— North East end .	31	49	0	129	51	0
	Asses Ears	32	2	30	128	36	30
	Gotto Islands,						
	— Cape Gotto, S. Pt.	32	35	0	128	41	0
	— North end . . .	33	34	0	129	10	0
	Fisando Island, Port	33	39	0	129	36	0
	Yki Island	33	56	0	129	48	0
	Tsus-sima I , N. Pt. .	34	40	30	129	29	30
	— South Point . .	34	6	30	129	15	0
	Sikoke Island,						
	— Cape Yamafar . .	34	10	0	133	17	0
	— Cape Misaki . .	33	18	0	132	17	0
	— Cape Tosa . . .	32	25	0	133	17	0
	— C. Mourodino-saki	33	8	0	134	21	0
	— Cape Ava . . .	33	52	0	135	0	0
	Niphon Island,						
	— Semonoseki, Port	33	0	0	131	20	0
	— Faghi	34	44	0	131	35	0
	— Famada	35	12	0	132	13	0
	— Cape Itsoumo . .	35	42	0	132	33	0
	— Tootori	35	36	0	134	27	0
Islands of Japan.	— Point Tanga . .	35	52	0	135	19	0
	— Cape Noto . . .	37	36	0	137	20	0
	— Cape Yetsiou .	37	17	0	137	50	0
	— Russ. Promontory	39	50	0	139	44	0
	— Cape Gamalas . .	40	37	0	139	49	0
	— Cape Greig . .	41	9	16	140	8	0
	— Cape Sangar . .	41	16	30	140	14	0
	— North Point . .	41	31	40	140	50	0
	— N. E. Point, or						
	Cape Nambu .	41	24	0	141	33	30
	— Port Nambu . .	39	48	0	142	25	0
	— Cape Gore . . .	38	39	0	141	52	0
	— Cape Blanc . . .	35	13	0	140	40	0
	— Cape King . . .	34	54	0	140	19	0
	— Jeddo, Town . .	35	40	0	139	50	0
	— Cape Yzou . . .	34	42	0	139	4	0
	— Cape Tootomy. .	34	42	0	138	14	0
	— Cape Sima . . .	34	21	0	137	18	0
	— South Point . .	33	25	0	135	47	0
	Mino-simo Island. .	35	1	0	131	30	0
	Oke Island, N. Point	36	30	0	133	17	0
	Jootsi-sima Island .	37	51	0	136	56	0
	Sado Island, N. Pt. .	39	4	0	138	20	0
	— South Point . .	38	23	0	138	24	0
	Vries Island, Volcano	34	40	0	139	32	0
	Broken Island . . .	34	21	0	139	37	0
	Vulcan Island . . .	34	5	0	139	34	0
	Princes Island . . .	33	48	0	139	50	0
	Broughton Rocks .	33	34	0	139	33	0
	Tatsisio Island . .	33	6	0	140	0	0
	South Island . . .	31	30	0	140	3	0
	——						
Matsmay or Jesso I.	Cape Esarme . . .	41	49	20	141	20	0
	Port Edermo . . .	42	19	30	141	7	30
	Cape Eroen . . .	41	59	0	142	55	0
	Bay of Good Hope,						
	— West Point . . .	43	0	0	144	12	0
	Atkis Bay, entr. . .	43	20	0	145	32	0
	Cape Broughton . .	43	38	30	146	7	30

	(70) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Cape Spanberg . .	44	35	0	145	0	0
Matsmay or Jesso I.	Cape Soya	45	31	15	141	51	0
	Cape Romanzoff .	45	25	50	141	31	20
	Cape Shishkoff .	44	20	0	141	37	0
	Cape Malespina . .	43	42	15	141	18	30
	C Novosilzoff, Peak .	43	14	30	140	25	30
	C. Koutousoff, Peak	42	38	0	140	1	0
	Cape Sineke . . .	41	39	30	139	51	15
	Matsumay, Town . .	41	32	0	140	4	0
	Cape Nadiejeda . .	41	25	10	140	9	30
	——						
	Kosima Island . .	41	21	30	139	46	0
	Osima Island . . .	41	31	30	139	19	15
	Okosu Island . . .	42	9	0	139	30	0
	Pic de Langle . . .	45	11	0	141	12	15
	Refunchery Island,						
	— N. E. Point . . .	45	27	45	141	4	0
	Monneron I., N. end	46	13	0	141	15	0
	——						
	Cape Crillon . . .	45	54	15	141	58	0
	Dangerous Rock . .	45	47	15	142	8	45
	Salmon Bay . . .	46	41	15	142	33	0
	Cape Aniva . . .	46	2	20	143	30	20
	Cape Lowenorn . .	46	23	10	143	40	0
	Cape Tonen . . .	46	50	0	143	33	0
Sachalin Island.	Cape Dalrymple . .	48	21	0	142	50	0
	Robben I., N. E. Pt.	48	36	0	144	33	0
	Cape Patience . .	48	52	0	144	46	15
	Cape Delisle de la						
	Croyere	51	0	30	143	43	0
	Downs Point . . .	51	53	0	143	14	0
	Cape Klokatchiff . .	53	40	0	143	7	0
	Cape Lowenstern . .	54	3	15	143	12	30
	Cape Elizabeth . .	54	24	30	142	46	30
	Cape Maria . . .	54	17	30	142	17	45
	Nadiejeda Bay . .	54	10	15	142	27	24
	Cape Golowatzcheff .	53	30	15	141	55	0
	Boutin Point . . .	51	52	0	141	54	0
	Martiniere Peak . .	50	12	0	142	12	0
	Mongez Peak . . .	49	20	0	142	15	0
	Bay D'Estaing . .	48	59	38	142	2	0
	Bay De Langle . .	47	44	0	141	58	0
	——						
	Kounashir Island,						
	— Traitor's Bay . .	43	41	0	145	15	0
	— North East Point .	44	29	15	146	8	0
	Itouroup Island,						
The Kurile Islands.	— Cape Ricord . .	44	29	0	146	34	0
	— Cape de Vries . .	45	37	0	149	1	0
	— N. E. Point . .	45	38	30	149	14	0
	Ouroup Island,						
	— South West Point	45	39	0	149	34	0
	— North East Point .	46	16	0	150	22	0
	North Torpoy Island	46	32	45	150	37	10
	South Torpoy Island	46	29	15	150	33	30
	Broughton Island .	46	42	30	150	28	30
	Simusir I., S. Point .	46	51	0	151	37	0
	— N. W. Point . .	47	11	0	151	55	0
	Ketoy Island, S. Point	47	17	30	152	21	0
	Ushishir I., S. Point	47	32	40	152	38	30
	Rashau Island . . .	47	47	0	152	55	0
	Mataua Island, mid .	48	6	0	153	12	30

LATITUDES AND LONGITUDES.

	(71) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Raoukoko Island . .	48	16	20	153	15	0
	Les Embuches, S. end	48	35	0	153	44	0
The Kurile Islands.	Tchirinkolan Island .	48	44	0	153	24	0
	Shiashkotan I. mid. .	48	52	0	154	8	0
	Ekarma Island . . .	49	0	0	154	8	0
	Kharamoukotan I peak	49	8	0	154	39	0
	Onnekotau I., S.W. Pt.	49	19	0	154	44	0
	Monkonrushy Island .	49	51	0	154	32	0
	Shirinky Island . . .	50	10	0	154	58	0
	Poromouchir Island,						
	— S. W. Peak . . .	50	15	0	155	12	0
	Soumshou Island, mid.	50	46	0	156	26	0
	Alaid Island . . .	50	54	0	155	32	0

XX. The Coasts of TASMANIA or VAN DIEMEN'S LAND and of AUSTRALIA or TERRA AUSTRALIS, with the adjacent Islands.

		South			East		
	West Point	41	3	30	144	38	0
	Mount Norfolk . .	41	24	0	144	58	30
	Macquarie Harbour,						
	— Cape Sorell . .	42	10	45	145	16	30
	Entrance Island . .	42	11	37	145	19	58
	Point Hibbs . . .	42	39	0	145	20	0
	Rocky Point . . .	43	0	30	145	33	0
	Port Davey,						
	— Pyramidal Rock .	43	21	0	145	59	0
	South West Cape . .	43	39	0	146	12	0
Tasmania or Van Diemen's Land.	South Cape . . .	43	38	0	146	50	0
	Mewstone	43	46	0	146	31	30
	Pedra Blanca . . .	43	50	30	147	7	0
	Rurick Rock . . .	44	0	0	147	45	0
	Recherche Bay,						
	— Observatory Point	43	32	47	147	2	30
	Var. 7° 39′ *E.*						
	Tasman's Head . .	43	31	30	147	26	0
	Storm Bay,						
	— Cape Raoul . .	43	13	0	147	54	0
	Hobart Town,						
	— Fort Mulgrave. .	42	53	35	147	28	0
	Cape Pillar . . .	43	11	40	148	6	0
	C. Frederik Hendrik .	42	51	30	148	4	0
	Maria Island, S. Pt.	42	45	0	148	9	0
	Schouten I., N. Pt. .	42	16	0	148	23	0
	St. Patrick's Head .	41	38	0	148	24	0
	Swan Islands, largest	40	43	30	148	6	15
	Cape Portland . .	40	44	0	147	56	30
	Port Dalrymple,						
	— Low Head . . .	41	3	30	146	47	30
	Var. 8° 30′ *E.*						
	Cape Grim	40	44	0	144	43	0
	Hunter's Islands,						
Bass' Strait.	— Albatros' Island .	40	25	0	144	40	30
	King's Island, N. Pt.	39	35	30	143	53	0
	— South Point . .	40	7	15	143	52	30
	Sir R. Curtis's Island	39	30	0	146	41	0
	Kent's Group, E. end	39	29	0	147	19	0
	Pyramid Rock . . .	39	52	40	147	11	30

	(72) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Furneaux Islands,						
Bass' Strait.	— Great I., N. end .	39	42	30	147	53	30
	— The Sisters, N. end	39	38	0	147	55	0
	— Babel Is., N. end	39	59	0	148	17	0
	— Cape Barren . .	40	25	15	148	25	45
	— Clarke's I , S. Pt.	40	33	0	148	9	30
	— Cape Franklin . .	40	24	0	148	0	0
	Banks' Strait, mid. .	40	38	0	148	8	0
	Cape Otway . . .	38	54	0	143	30	0
	Port Philip,						
	— Point Nepean . .	38	18	0	144	38	0
	Western Port,						
	— Cape Schank . .	38	30	0	144	53	0
	Var. 8° 30′ *E.*						
	— Point Grant . .	38	30	0	145	8	0
	Cape Liptrap . . .	38	53	0	145	54	30
	Wilson's Promontory	39	11	0	146	25	0
	Ram Head	37	38	0	149	41	0
	Cape Howe . . .	37	30	0	150	7	0
	Twofold Bay,						
	— Snug Cove . . .	37	4	0	150	4	0
	Cape Dromedary . .	36	18	0	150	11	0
	Cape George . . .	35	9	0	150	56	0
	Jervis Bay,						
	— Bowen's Island .	35	6	0	150	55	0
	Red Point	34	29	0	151	2	0
	Botany Bay,						
	— Point Solander .	34	0	45	151	15	50
	Port Jackson,						
New South Wales.	— Lighthouse . . .	33	51	11	151	19	45
	Var. 8° 42′ *E.*						
	— Sidney	33	50	40	151	14	0
	Paramatta, obs. . .	33	48	50	151	1	34
	Broken Bay, S. Head	33	34	0	151	21	0
	Port Hunter, entr. .	32	56	0	151	43	15
	Cape Stephens . .	32	47	35	152	11	40
	Cape Hawke . . .	32	13	30	152	33	0
	Port Macquarie, entr.	31	25	32	152	57	25
	Var. 10° 11′ *E.*						
	Smoky Cape . . .	30	55	40	153	4	30
	Shoal Bay, entr. . .	29	26	15	153	22	0
	Cape Byron . . .	28	38	10	153	37	20
	Point Danger . . .	28	7	0	153	32	0
	Point Lookout . . .	27	27	0	153	31	0
	Brisbane River . .	27	25	0	153	5	0
	Cape Moreton . . .	27	1	0	153	26	20
	Double Island Point .	25	55	0	153	14	0
	Indian Head . . .	25	1	0	153	23	0
	Sandy Cape . . .	24	42	0	153	16	0
	Port Curtis,						
	— Gatcombe Head .	23	52	30	151	24	0
	Cape Capricorn . .	23	28	30	151	15	0
	Cape Keppel . . .	23	27	0	151	4	0
	Keppel Islands,						
	— Largest, N. end .	23	8	0	150	57	0
	Cape Manifold . .	22	42	0	150	49	0
	Port Bowen . . .	22	28	28	150	45	30
	Harvey's Islands . .	22	24	30	150	44	0
	Cape Townshend . .	22	13	30	150	29	0
	Thirsty Sound,						
	— Pier Head . . .	22	6	53	150	0	10

TABLE LVI.

LATITUDES AND LONGITUDES.

	(73) Places.	Lat. S.			Lon. E.		
		°	'	"	°	'	"
	Percy Islands, N. end	21	29	0	150	15	0
	Cape Palmerston . .	21	27	0	149	28	0
	Cape Hilsborough .	20	53	40	149	0	15
	Sir J. Smith's Group,						
	— Linné Peak . .	20	40	30	149	9	10
	Shaw's Peak . . .	20	28	0	149	2	55
	Penticost Island . .	20	23	10	148	59	30
	Repulse Bay,						
	— Cape Conway . .	20	32	0	148	54	0
	Gloucester I., N. end	19	57	24	148	23	38
	Cape Gloucester . .	20	1	50	148	26	15
	Cape Upstart . . .	19	41	50	147	44	30
	Cape Bowling Green	19	19	10	147	23	0
	Cape Cleveland . .	19	10	10	146	57	56
	Mount Elliot . . .	19	33	10	146	54	25
	Magnetic Island, mid.	19	7	30	146	46	0
	Palm Island, mid. .	18	43	5	146	35	15
	Point Hillock . . .	18	25	0	146	20	0
	Mount Hinchinbrook	18	21	30	146	15	0
New South Wales.	Cape Sandwich . .	18	13	20	146	16	40
	Double Point . . .	17	39	50	146	6	0
	Fitzroy I., S. W. end	16	55	21	145	56	21
	Cape Grafton . . .	16	51	20	145	53	5
	Snapper Island . .	16	17	35	145	27	40
	Endeavour R., entr. .	15	27	4	145	10	49
	Cape Bedford . . .	15	16	19	145	17	19
	C. Flattery, summit .	14	52	30	145	16	10
	Lizard Island, summit	14	40	20	145	23	0
	Cape Bowen, Peak .	14	34	30	144	35	40
	Point Barrow . . .	14	21	0	144	33	30
	Cape Melville . .	14	9	30	144	24	50
	Cape Flinders . . .	14	8	0	144	10	20
	Clack's Island . . .	14	4	45	144	11	45
	Cape Sidmouth . .	13	21	20	143	30	0
	Night Island, N. end	13	8	0	143	28	40
	Cape Direction . .	12	51	30	143	27	0
	Cape Weymouth . .	12	37	15	143	20	35
	Fair Cape	12	25	0	143	11	15
	Cape Grenville . .	11	57	30	143	8	0
	Quoin Island . . .	12	24	0	143	23	50
	Forbes's Island . .	12	16	35	143	18	50
	Sir Ch Hardy's Is. .	11	53	20	143	23	40
	Bird Is. N. E. end .	11	44	15	142	58	45
	Orfordness	11	18	30	142	43	35
	Cairncross I., mid. .	11	13	30	142	50	35
	Turtle Island . . .	10	54	0	142	38	40
	Albany Islands, Peak	10	43	45	142	35	5
	——						
	York Islands,						
	— Mount Adolphus .	10	38	20	142	36	25
	Cape York	10	42	40	142	28	50
	Endeavour Strait,						
Torres Strait.	— Possession Islands	10	44	0	142	20	0
	Prince of Wales's Is.,						
	— Horned Hill . .	10	36	35	142	15	0
	— Cape Cornwall .	10	45	45	142	8	36
	— Wednesday Island,						
	North Point . .	10	30	10	142	15	0
	Wallis's Island, mid.	10	51	0	142	0	0
	Booby Island, mid. .	10	36	0	141	52	50
	Alerts Shoal . . .	9	52	0	140	50	0
	West Island . . .	10	21	0	141	56	30

	(74) Places.	Lat. S.			Lon. E.		
		°	'	"	°	'	"
	Hawkesbury Island .	10	23	0	142	5	0
Torres Strait.	Spencer's Island . .	10	18	30	142	4	30
	Mount Earnest . .	10	14	30	142	26	0
	Bank's Island,						
	— Mount Augustus .	10	11	30	142	14	30
	Mulgrave's Island,						
	—North East Point .	10	4	0	142	8	0
	Jervis's Island, mid.	9	57	[illegible]	142	7	0
	——						
	Duythen's Point . .	12	34	0	141	37	0
	Pera Head	12	58	30	141	37	0
	Cape Keerweer . .	13	57	0	141	30	0
	Siveer's Island . .	17	8	15	139	44	52
	Allen's I., S. E. end .	17	5	0	139	25	0
	Wellesleys Islands,						
	— Bountiful Island .	16	41	0	139	59	0
Gulf of Carpentaria.	—Mornington Island,						
	Cape Vandiemen .	16	32	0	139	49	30
	Sir Ed. Pellew's Is.,						
	— Cape Vanderlyn .	15	34	30	137	11	20
	— Cape Pellew . .	15	30	30	137	5	0
	Maria's Island, N.Pt.	14	50	0	135	57	30
	Groote I., S. W. Pt. .	14	15	0	136	30	0
	— South East Point .	14	17	0	137	7	30
	— North Point . .	13	37	0	136	50	0
	— Central Hill . .	13	56	45	136	46	30
	Bickerton's I. summit	13	44	40	136	19	15
	Cape Shield . . .	13	19	45	136	28	0
	Cape Grey	13	1	0	136	47	0
	Mount Caledon . .	12	53	30	136	37	40
	Point Alexander . .	12	50	0	136	43	30
	Mount Alexander . .	12	40	0	136	48	0
	——						
	Cape Arnheim . . .	12	18	0	137	5	0
	Melville's Islands,						
New South Wales.	— Great I., S. end .	12	8	30	136	58	0
	Melville Bay,						
	— Point Dundas . .	12	13	0	136	46	0
	Cape Wilberforce .	11	52	0	136	38	0
	Arnheim Bay, entr. .	12	2	0	136	9	0
	Cunningham's Island,						
	— South end . . .	11	44	0	136	14	0
	Point Dale	11	36	0	136	9	0
	Wessel's Islands,						
	— Cape Wessels . .	10	59	15	136	46	30
	——						
	Cape Stewart . . .	11	56	0	134	48	0
	Liverpool River,						
	— Entrance Island .	11	57	0	134	14	50
	Point Braithwaite .	11	45	50	133	55	20
	Goulburn's Islands,						
New Holland.	— North East end .	11	26	0	133	26	0
	Cape Cockburn .	11	18	0	132	53	5
	Croker's I., N. Pt. .	10	58	30	132	34	10
	Point Smith . . .	11	6	45	132	12	30
	Cape Don	11	19	30	131	45	30
	Alligator Rivers,						
	— Field Island, mid.	12	6	0	132	25	10
	Melville Island,						
	— Cape Gambier . .	11	56	0	130	55	0
	— Cape Keith . .	11	39	0	131	28	0
	- Cape Fleeming .	11	12	0	131	22	0

LATITUDES AND LONGITUDES.

New Holland.

(75) Places.	Lat. S.			Lon. E.		
	°	′	″	°	′	″
Melville Island,						
— Cape Van Diemen	11	8	15	130	20	30
— Port Cockburn,						
Fort Dundas . .	11	25	0	130	24	0
Bathurst Island,						
— North Point . .	11	19	0	130	13	0
— Port Hurd, entr. .	11	39	30	130	11	0
— Cape Fourcroy .	11	51	0	130	0	0
Paterson's Bay,						
— Cape Grose . . .	12	32	40	130	26	0
Peron's Islands, peak	13	6	30	130	1	20
Cape Ford	13	24	35	129	52	20
Port Keats,						
— Tree Point . . .	13	59	20	129	34	0
Cape Hay	14	1	30	129	27	30
Point Pearce . . .	14	24	30	129	17	15
Cambridge Gulf,						
— Lacrosse I., W. end	14	43	0	128	13	0
— Cape Domett . .	14	47	0	128	23	0
— Cape Dussejour .	14	42	0	128	8	0
Cape Londonderry .	13	44	0	126	53	50
Jones's Island . . .	13	44	0	126	23	0
Troughton's Island .	13	44	10	126	11	15
Cape Bougainville .	13	52	0	126	9	0
Cassini Island, mid. .	13	55	5	125	42	0
Admiralty Gulf,						
— Cape Voltaire, Hill	14	14	30	125	40	12
Port Warrender,						
— Chrystal Head . .	14	28	0	125	55	30
Montalivet Islands,						
— N. E. end . . .	14	13	40	125	19	30
Maret Islands, N. end	14	22	15	124	56	40
York Sound,						
— Cape Pond . . .	14	45	20	125	9	25
Port Nelson,						
— Careening Bay .	15	6	18	125	0	46
Freycinet's Islands .	15	0	30	124	32	40
Prince Regent's R.,						
— Mount Trafalgar .	15	16	35	125	4	0
Port George IV.,						
— High Bluff . . .	15	14	40	124	41	35
— Point Adieu . .	15	14	10	124	34	45
Red Island	15	13	15	124	15	45
Cockell's Islands . .	15	48	0	124	4	0
MacLeay's Is., largest	15	57	0	123	42	0
Cafferelli Island . .	16	2	25	123	18	35
Point Cunningham .	16	39	20	123	10	0
Cape Lévêque . . .	16	21	50	122	56	35
Cape Borda	16	36	0	122	45	0
Lacépède Is., N.W. end	16	49	40	122	7	20
Baleine Bank, mid. .	16	46	0	121	50	30
Cape Baskerville . .	17	10	0	122	16	0
Point Coulomb . .	17	21	0	122	11	0
Cape Boileau . . .	17	38	0	122	14	0
Point Gantheaume .	17	53	0	122	11	0
Cape Villaret . . .	18	19	15	122	3	45
C. Latouche Treville	18	29	0	121	50	50
Cape Bossut . . .	18	44	0	121	41	0
Cape Jaubert . . .	18	55	0	121	36	0
Bedout Island . . .	19	29	0	118	52	0
Cape Lambert . . .	20	34	30	117	7	0
Delambre I., N. end .	20	23	35	117	1	25

New Holland.

(76) Places.	Lat. S.			Lon. E.		
	°	′	″	°	′	″
Legendre I., N.W. Pt.	20	18	45	116	46	0
Dampier's Archipelago						
— Malus Island,						
Courtenay Head .	20	29	5	116	36	35
— Enderby I., S.W. Pt.	20	35	25	116	23	5
— Rosemary Island .	20	27	30	116	31	0
Cape Preston . . .	20	49	45	116	5	0
Trimouille I., E. end	20	23	0	115	28	0
Barrow's Island,						
— Cape Dupuy . .	20	40	0	115	12	0
— Cape Poivre . .	20	52	0	115	9	0
Ritchie's Reef . . .	20	17	40	114	46	6
Exmouth Gulf,						
— N. W. Cape . .	21	47	40	114	3	40
Point Cloates . . .	22	33	5	113	35	0
Cape Farquhar . .	23	35	0	113	35	35
Cape Cuvier . . .	24	0	30	113	21	48
Shark's Bay,						
— Foure I., mid. . .	25	43	0	114	6	0
— C. Lesueur . . .	25	38	0	113	26	0
— Cape Heurisson .	25	57	0	113	26	0
— C. Bellifin . . .	25	57	0	113	18	0
Bernier Island,						
— Cape Ronsard . .	24	45	0	113	7	0
Dorre Island,						
— C. St. Creque . .	25	18	0	113	0	0
Naturaliste's Channel	25	25	0	112	57	0
Dirk Hartog's Island,						
— Cape Inscription .	25	28	20	112	55	0
Houtman's Abrolhos,						
— South East part .	28	55	0	113	47	0
Cape Leschenault . .	31	21	0	115	30	0
Swan River, entrance	32	4	31	115	46	43
Rottnest I., N. E. Pt.	31	59	30	115	31	12
Var. 4° 50′ W.						
Cape Peron	32	18	0	115	42	0
Cape Bouvard . . .	32	37	0	115	33	0
Cape Naturaliste . .	33	27	30	114	57	53
Cape Leeuwin . . .	34	20	0	115	7	0
Low Black Point . .	34	25	0	115	30	0
Point D'Entrecasteau	34	52	0	116	1	0
White Topped Rocks	35	3	0	116	13	0
Cape Chatham, Rocks	35	3	0	116	29	0
Point Hillier . . .	35	4	0	117	9	0
West Cape Howe . .	35	8	30	117	40	0
Eclipse Is., S. end .	35	13	0	117	52	0
King George's Sound,						
— Bald Head . . .	35	6	15	118	0	45
Mount Gardner . .	35	0	30	118	10	0
Bald I., S. E. Point .	34	55	0	118	29	0
Haul off Rock . . .	34	43	0	118	39	0
Cape Knob	34	33	0	119	14	0
Doubtful Islands . .	34	23	0	119	35	0
Seal's Island . . .	34	6	0	120	28	0
Esperance Bay,						
— Observatory I., mid.	33	55	30	121	45	30
— Cape Le Grand .	34	1	0	122	4	0
Lucky Bay, S. E. Pt.	34	0	20	122	14	14
Mondrain I., S.W. Pt.	34	10	30	122	13	0
Termination Island .	34	30	20	121	58	0
Twin Rocks . . .	34	24	0	122	11	50
Twin Peaks, S.W. end	34	1	0	122	47	0

	(77) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Middle Island,						
	— Goose Island Bay	34	5	23	123	9	30
	Douglas's Islands, mid.	34	10	0	123	6	20
	Cape Arid	34	0	15	123	13	0
	South East Is., S. end	34	20	30	123	27	0
	Cape Pasley	33	57	0	123	26	0
	Round Island	34	5	0	123	49	30
	Point Malcolm	33	48	0	123	41	30
	Eastern Group, S. end	33	51	0	124	3	0
	Point Culver	32	57	0	124	39	0
	Point Dover	32	34	0	125	30	0
	1st. Low Sandy Point	32	21	30	126	29	0
	2nd. Low Sandy Point	32	1	0	128	15	0
New Holland.	Head of the Great						
	Australian Bight	31	29	0	131	8	0
	Cape Nuyts	32	2	0	132	18	0
	Point Fowler	32	2	0	132	27	0
	Point Bell	32	16	30	133	5	0
	Purdie's Is., W. end	32	20	20	133	10	15
	St. Francis's Is., W. end	32	33	30	133	13	30
	St. Peter's Is., W. end	32	22	20	133	27	0
	Franklin's Is., S.W. end	32	31	0	133	35	0
	Point Brown	32	37	0	133	48	0
	Cape Bauer	32	44	20	133	58	30
	Point Westall	32	52	30	133	58	45
	Cape Radstock	33	12	0	134	15	0
	Point Weyland	33	14	0	134	33	0
	Waldegrave's Is.,						
	— West end	33	35	30	134	42	30
	Flinders' I., S.W. Pt.	33	45	30	134	24	15
	Pearson's Is., N. Peak	33	57	0	134	13	0
	——						
	Point Drummond	34	10	0	135	13	0
	Coffin's Bay,						
	— Point Sir Isaac	34	27	0	135	10	0
	Point Whidley	34	36	30	135	3	30
	Greenly Is., peak	34	40	0	134	47	0
	Cape Wiles	34	57	0	135	38	30
	Liguanea Island	34	59	30	135	34	0
	Cape Catastrophe	35	0	0	135	56	0
	Thistle's Island, N. end	34	56	0	136	4	0
	Spencer's Gulf,						
	— Cape Donington	34	44	0	135	56	30
New South Wales.	— Port Lincoln, anch.	34	48	25	135	44	51
	— Point Bolingbroke	34	32	40	136	3	0
	— Reevesby Island,						
	N. E. end	34	29	0	136	18	0
	— Mount Young	33	6	0	137	30	0
	— Point Lowly	32	57	40	137	49	0
	— Mount Brown	32	30	15	138	0	45
	— Barn Hill	33	35	0	138	8	0
	— Point Riley	33	53	0	137	30	0
	— Point Pierce	34	28	30	137	21	0
	— Corny Point	34	52	0	137	3	0
	— Cape Spencer	35	18	0	136	53	0
	Troubridge Hill	35	8	0	137	41	30
	Gulf St. Vincent, head	34	8	52	138	6	0
	— Mount Lofty	34	59	0	138	42	0
	Cape Jervis	35	38	0	138	9	0
	Kangaroo Island,						
	— Point Marsden	35	33	0	137	41	0
	— Kangaroo Head	35	43	0	137	58	31

	(78) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	— Cape Willoughby	35	48	0	138	13	0
New South Wales.	Cape Bernouilly	36	34	0	139	51	0
	Cape Jaffa	36	57	0	139	41	30
	Cape Lannes	37	10	30	139	45	0
	Cape Buffon	37	36	0	140	10	0
	W. Cape Banks	37	53	30	140	23	20
	Cape Northumberland	38	2	30	140	37	30
	Cape Bridgewater	38	22	0	141	18	0
	Cape Nelson	38	24	30	141	28	0
	Cape Otway	38	54	0	143	30	0

XXI. Islands, Rocks, and Shoals in the NORTH PACIFIC OCEAN.

		North			East		
	Borodino Island	25	56	0	131	15	0
	Bishop's Rock	25	20	0	131	15	0
	Rasa Island	24	26	0	131	3	0
	Kendrick's Island	24	35	0	134	20	0
	Cooper's Island	25	48	0	131	36	0
	Copper Island	20	8	0	131	54	0
	Abreojos Shoal	22	10	0	132	55	15
	Abreogoes Shoal	20	59	0	136	38	0
	Douglas' Reef	20	37	0	136	10	0
	Bishop's Rock	20	15	0	136	54	0
	Moore's Island	31	27	0	145	40	0
	St. Peter's Island	30	30	30	140	15	0
	Disappointment I.	27	15	0	139	45	0
	Sylph's Rock	31	25	0	142	40	0
	Bonin Is. Port Loyd	27	5	35	142	11	30
	Parry's Group, S. end	27	37	30	142	11	0
	Coffin's Group	26	30	0	141	10	0
	Sulphur Island	24	48	0	141	13	0
	Forfana Island	25	34	0	143	0	0
	Margaret's Island	27	20	0	145	45	0
	Grampus' Islands	25	40	0	146	40	0
	——						
	Volcano or Guy's I.	20	30	0	145	46	0
	Uracas Island	20	10	0	145	32	0
	Assumption Island	19	41	0	145	27	0
	Mang's Island	19	57	0	145	19	30
Ladrone or Marian Islands	Grijan Island, N. Pt.	18	50	30	145	50	30
	Pagon Island, N. Pt.	18	16	30	146	0	0
	Alamaguan Island	18	5	0	146	2	0
	Guguan Island, N. Pt.	17	35	30	146	3	30
	Tores Rock	17	16	30	146	3	0
	Seriguan Island	16	40	0	146	0	0
	Anatajan Island	16	20	0	145	52	0
	Medinilla Rocks	16	0	0	146	13	0
	Saypan Island, peak	15	14	30	145	56	0
	Tinian Island, S. Pt.	14	58	0	145	51	15
	Agugan Island	14	53	44	145	44	0
	Rota Island	14	9	0	145	29	30
	Guam Island, N. Pt.	13	38	0	145	4	0
	— Apra, Fort	13	25	50	144	51	15
	— Umatac Bay	13	17	15	144	52	0
	— South West Point	13	13	0	144	56	0
	Sta. Rosa Bank, mid.	12	24	0	144	24	0
	——						
	Manurvan Island	0	30	30	130	48	0
	Lord North's Island	3	2	45	131	4	15

TABLE LVI.

LATITUDES AND LONGITUDES.

	(79) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Helen's Shoal . . .	2	50	0	131	40	30
	Pulo Anna	4	38	30	132	3	30
	Pulo Mariere . . .	4	19	30	132	28	15
	St. Andrew's Islands	5	20	0	132	16	0
	St. David's Island .	0	55	0	134	21	30
	——						
	Pellew Islands,						
	— Babelthouap, E.Pt.	7	41	0	134	55	0
	— Northernmost . .	8	8	30	134	50	0
	— Southernmost . .	6	53	30	134	21	0
	Matelotas Is., N. end	8	41	0	137	40	0
	— South end . . .	8	17	0	137	33	30
	Yap Island, S. end .	9	30	30	138	8	0
	Hunter's Shoal . .	9	57	0	138	10	0
	Mackenzie's Is., mid.	10	5	0	139	40	0
	Phillip's Islands . .	8	6	0	140	50	0
	Kama Islands . . .	6	30	0	143	0	0
	Wilson's Islands . .	7	16	0	144	48	0
	Faralis Island . . .	9	2	0	145	5	0
	Five Islands . . .	7	32	0	145	31	0
	Swedes Island . .	7	30	0	146	28	0
	Haweis Islands ? . .	7	30	0	146	38	0
	Tucker's Island . .	7	22	0	146	48	0
	Pigali Island . . .	8	11	53	147	40	10
	St. Bartholomew's I.	6	35	0	148	47	0
New Phillippines or Caroline Islands.	Enderby or Kata Is.	7	18	0	149	12	0
	Poulousouk Island .	6	40	0	149	23	0
	Martires Islands,						
	— Tamatam . . .	7	32	17	149	29	53
	— Tanadick . .	7	34	18	149	28	38
	— Olap	7	37	17	149	30	34
	Anonymous Island .	8	36	0	150	21	0
	Hall's Islands . . .	8	45	0	152	0	0
	Hogoleu Islands,						
	— Piso Island . .	7	42	35	151	49	15
	— Givry Island . .	7	8	55	151	51	48
	— Torres Island . .	7	20	0	151	28	0
	— Easternmost I. .	7	33	0	151	59	0
	Somes' Island . . .	7	20	0	151	14	0
	Royalist Island . .	6	47	0	152	8	0
	D'Urville Island . .	7	5	18	152	36	52
	Reefs and Islands,						
	— North East end .	8	45	0	152	36	0
	— South West end .	8	28	0	152	6	0
	Mortlock's Islands .	5	25	0	153	25	0
	San Raphael's Island	7	18	0	153	54	0
	Greenwich Island .	1	0	0	154	30	0
	Bordelaise Island . .	7	39	0	155	5	0
	Meaburn's Island . .	7	44	0	155	18	0
	Montevarde Island .	3	27	30	155	48	0
	Raven or Valient's Island	5	40	0	157	40	0
	St. Augustin's Island	7	24	0	158	2	0
	Ascension Island . .	6	48	0	158	25	0
	Musgrave Islands . .	6	15	0	159	15	0
	Wellington or Duperry's Islands .	6	39	40	159	49	3
	Mc. Asgill's Islands .	6	13	30	160	48	0
	Qualan Island . . .	5	21	30	163	0	42
	Arrecifos Islands . .	9	31	0	161	8	0
	Brown's Range,						
	— Parry's Island . .	11	21	0	162	52	0

	(80) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Ralick Islands,						
	— Eschscholtz Is., West end . . .	11	40	0	165	24	25
	— Rimsky Korsakoff Islands, N. end .	11	31	0	166	58	0
	— South West end .	11	8	20	166	26	30
	— Pescadores Is., mid.	11	19	12	167	35	0
	— Catharine Island .	9	11	0	166	32	0
	— Lydia Island . .	9	4	0	166	28	0
	— Margaret's Island	8	52	0	166	30	0
	— Princess Island .	8	20	0	167	30	0
	— Musquillo Groupe, middle	7	36	0	168	16	0
	— Elmore Is., mid. .	7	26	0	168	30	0
	— Bonham Is. S.E. end	6	0	0	169	49	20
	— Hunter's Island .	5	46	0	169	0	0
Marshall's Archipelago.	— Baring's Islands .	5	55	0	168	13	0
	— Boston Island . .	4	45	0	168	10	0
	Radack Islands,						
	— Dawson's Is., mid.	11	48	0	170	7	0
	— Button's or Koutousoff Islands, mid.	11	11	20	169	50	30
	— Krusenstern's Is., North end . . .	10	27	15	170	0	0
	— New Year's Island	10	8	30	170	55	15
	— Temo Island	9	[illegible]	0	169	45	0
	— Heiden Is. mid .	[illegible]	51	30	169	13	0
	— Chatham Islands	[illegible]	9	30	170	24	0
	— Romanzoff Islands, Port Noel . . .	9	28	10	170	16	50
	Var. 17° 55′ E.						
	— Calvert Islands,						
	North West end .	8	54	20	170	49	0
	South East end . .	8	29	30	171	11	0
	— Ibbetson's Is., mid.	8	18	40	171	12	0
	— Arrowsmith's Is., about	7	10	0	171	0	0
	Daniel's Islands . .	7	24	0	172	6	0
	Pedder's Islands . .	7	10	0	171	54	0
	Mulgrave Is. S.E. end	5	51	0	172	12	0
	— North East end .	6	20	0	172	30	0
	— North West end .	6	20	0	172	4	0
	— South West end .	5	58	0	172	0	0
	——						
	Charlotte's Islands .	1	55	0	172	55	0
	Pitt's Island, about .	3	0	0	174	30	0
	Matthew's I., N. end	2	6	0	173	27	20
	Knoy's Is. S. end .	1	20	0	173	0	40
Gilbert's Archipelago.	Marshall's or Gilbert's Island, mid. . .	1	16	15	173	4	20
	Hall's Island, N end	0	59	19	173	4	45
	Woodle I., N. end .	0	16	0	173	27	15
	— South end . . .	0	10	50	173	29	40
	Henderville Is., N. end	0	12	10	173	42	0
	— South end . . .	0	5	50	173	43	0
	Phebe Island . . .	0	12	0	176	50	0
	Kingsmill's Groupe,	South					
	— Dundas Island ? .	0	15	0	174	0	0
	Sydenham Is., N. end	0	32	0	174	24	0
	— South end . . .	0	47	0	174	34	0
	— Drummond's I., North end . . .	1	1	0	174	46	0

LATITUDES AND LONGITUDES.

(81) Places.	Lat. S.			Lon. E.		
	°	′	″	°	′	″
— Drummond's Is. South end . . .	1	33	30	175	10	50
— Nautilus' Reef .	1	33	40	175	5	0
— Byron's Island .	1	18	0	177	45	0
——	North					
Jardines or Marshall's Island	21	40	0	151	35	0
Bennett's Island . .	24	19	0	154	36	0
Wakes Reef . . .	33	0	0	153	0	0
Rico de Oro or Lot's Wife	29	51	0	157	4	0
Colunas Islands . .	28	53	0	158	0	0
Decker's Island . .	23	24	0	163	5	0
St. Bartholomew's I.	15	10	0	163	43	0
Halcyon Island . .	19	23	0	163	33	0
Wake's Island . . .	19	0	0	166	40	0
Gasper Rico or Cornwallis Islands .	14	30	0	168	42	0
Crespo Island, or Roco de Plata	32	46	0	170	10	0
Wake's Rock . . .	17	40	0	172	40	0
Patrocino Island . .	28	9	0	175	48	0
Mellish's Bank . .	34	0	0	178	18	0
Gaspar Island . . .	15	0	0	176	18	0
Massachuset's Islands	22	28	0	176	40	0
				West		
Ocean's or Staver's I.	28	24	0	178	42	0
Curé Island . . .	28	25	0	178	25	0
Barbas Island . . .	8	54	0	178	0	0
Pearle and Hermes Bank	27	46	0	176	0	0
Krusenstern's Rock .	22	15	0	175	47	0
Lisiansky's Island .	26	3	0	173	42	0
Lassion's Island . .	26	6	0	173	33	0
Bunker Island . . .	28	0	0	173	30	0
Maro's Reef . . .	25	28	0	170	20	0
Johnston's or Smith's Island	16	53	20	169	31	30
Two Brother's Rocks	24	14	0	168	30	0
Polland's Island . .	24	48	0	168	0	0
Allen's Breakers . .	25	0	0	167	54	0
Gardner's Island . .	25	3	0	167	40	0
Wilson's Island . .	19	21	0	166	55	0
French Frigate Shoal	23	45	0	165	50	0
Malloon's Island . .	19	23	0	165	23	0
——						
Necker Island . . .	23	34	0	164	32	0
Bird's Island . . .	23	6	0	161	52	0
Tahoora Island . .	21	39	0	160	32	0
Oneehou Island, S. Pt.	21	46	30	160	10	0
Sandwich Islands.						
Oreehoua Island . .	22	2	0	160	7	0
Atooi Island, S. E. Pt.	21	51	0	159	30	0
— West Point . .	22	4	0	159	50	0
— Whymea Road .	21	54	0	159	41	45
Woahoo Island, E. Pt.	21	19	30	157	40	0
— North Point . .	21	43	0	158	0	0
— Honorooroo Port .	21	17	57	157	56	0
Var. 10° 0′ *E.*						
— Whymea Bay . .	21	38	0	158	0	0
— Whyteete Road .	21	16	42	157	47	0
Morotoi Island, E. Pt.	21	9	0	156	44	0
Ranai Island, N.W. Pt.	20	58	30	157	3	0

(82) Places.	Lat. N.			Lon. W.		
	°	′	″	°	′	″
Marokinni Island . .	20	37	0	156	30	0
Tahoorowa Island, — North East Point .	20	36	0	156	34	0
Mowee I., N. W. Pt.	21	3	0	156	37	0
Sandwich Islands.						
— East Point . . .	20	44	40	156	2	40
— Raheina Bay . .	20	50	0	156	41	0
Owhyhee or Hawaii I., — North Point . .	20	18	30	155	58	0
— South Point . .	18	54	0	155	45	0
— East Point . . .	19	32	0	154	50	0
— Whytee or Byron's Bay	19	43	51	155	7	10
— Karakakoa Bay .	19	28	2	156	0	0
Var. 10° 14′ *E.*						
— Kowrooa Bay . .	19	37	30	156	5	30
— Toeaigh Bay . .	20	3	0	155	58	0
——						
Palmyra Island . .	5	50	0	162	30	0
Prospect Island . .	4	44	0	161	37	0
Washington's Island .	4	30	0	159	50	0
America Islands . .	3	48	0	159	15	0
Fanning's Island . .	3	49	0	158	50	0
Christmas or Noel I.	1	58	0	157	32	0
Guadaloupe I., S. Pt.	28	53	0	118	15	45
Roca Pardora Island .	16	10	0	156	10	0
Misipi Island . . .	16	21	0	132	57	0
Alijos Rocks? . . .	24	48	0	115	33	0
Sta. Rosa Island . .	18	19	0	115	6	30
Shelvoes Island . .	22	5	0	112	32	0
Neublada	18	17	0	114	3	0
Roca Partida . . .	19	4	30	111	6	30
Cloud's Island . . .	19	46	0	116	0	0
Best's Island . . .	18	4	0	114	21	0
Socorro Island — Cornwallis Bay .	18	48	0	110	10	0
St. Berto Island .	19	20	0	109	52	0
Passion Rock . . .	16	54	0	109	6	0
Clipperton Rock . .	10	18	0	109	19	0
Duncan's Island . .	6	0	0	106	0	0
Cocos Island . . .	5	33	10	86	59	0
Malpello Island . .	3	59	0	81	10	0
——						
Culpepper's Island .	1	42	0	91	34	0
Wenman's Island . .	1	22	0	91	16	0
Abingdon's Island, — Nories' Rocks . . .	0	48	0	90	20	40
— Cape Ibbetson . .	0	30	45	90	15	45
— Chalmers' Point .	0	31	30	90	20	15
Galapagos Islands.						
Bindlo Island, N. Pt.	0	21	15	90	6	0
Euro Island	0	22	30	89	42	0
Albemarle Island, — Albemarle Point .	0	15	0	90	58	0
— Cape Marshall . .	0	1	30	90	50	0
— Cape Berkley . .	0	4	0	91	21	30
	South					
— Cape Barrington .	0	48	30	90	37	0
— Cape Woodford .	0	56	0	90	36	0
— Cape Rose . . .	1	0	0	90	52	0
— Cape Christopher	0	51	0	91	12	0
James' Island . . .						
— Cape Stephens . .	0	5	0	90	22	0
— Cape Nepean .	0	28	0	90	26	0

TABLE LVI.

LATITUDES AND LONGITUDES.

Galapagos Islands.

(83) Places.	Lat. S.			Lon. W.		
	°	′	″	°	′	″
James' Island,						
— Sugar Loaf . . .	0	18	0	90	26	0
Narborough Island,						
— Cape Douglas . .	0	17	0	91	22	0
— Cape Hammond .	0	32	30	91	10	15
Enchanted Island .	0	31	0	90	40	0
White Rocks . . .	0	33	36	90	32	0
Norfolk Island,						
— East Point . . .	0	41	0	90	3	0
— West Point . .	0	40	0	90	20	30
— North East Point	0	33	36	90	10	0
Barrington Island,						
— North East Point .	0	49	0	89	48	30
— South West Point	0	55	0	89	56	0
Crossman Island . .	0	57	0	90	28	0
Bruttle Island . . .	0	59	0	90	37	0
Chatham I., E. Pt. .	0	49	0	88	47	0
— West Point . .	1	1	30	89	25	0
Hood Island,						
— Gardner's Bay .	1	18	0	89	30	0
Champion Island . .	1	14	0	89	58	15
Enderby Island . .	1	17	0	90	0	0
Watson's Island . .	1	20	0	89	58	0
Gardner's Island . .	1	23	0	89	57	30

XXII. Islands, Rocks, and Shoals in the SOUTH PACIFIC OCEAN.

	South			East		
New Guinea,						
— Cape Saley . . .	1	26	0	131	3	0
— Cape of Good Hope	0	20	0	132	31	0
— Cape Dory or Flat Point . . .	0	46	0	134	25	0
— Cape Valsh . .	8	22	0	137	41	0
— Cape Rodney . .	10	3	0	148	30	0
— South East Cape .	8	42	55	148	25	0
— Riche Island, North Point . .	8	2	0	147	57	20
— Cape Longuehue .	7	22	0	147	23	20
— Cretin Is., S. end	6	47	45	147	49	40
— King William's C.	6	16	30	147	44	0
Torres or Endeavour Straits,						
— Pandoras' Reef .	11	24	0	143	58	0
— Murray's Island .	9	54	0	144	0	0
— Darnley's Island .	9	33	0	143	41	0
— Halfway Island .	10	7	0	143	16	0
— Booby Island . .	10	36	0	141	52	50
— Turnagain Island .	9	34	0	142	17	0
— Deliverance Island	9	32	0	141	42	0
Louisiade Islands,						
— Satisfaction or Roussel Island, Cape Deliverance	11	20	37	154	26	0
— Renard Is., W. end	10	52	40	153	1	0
— St. Aignan Island, Cape Henry . .	10	41	15	152	56	0
D'Entrecasteaux Is. Cape Pierson . .	9	55	10	151	14	50
— Jouveney Island .	8	43	0	151	43	0
— Jourien Island .	8	37	0	151	22	0

(84) Places.	Lat. S.			L n. E.		
	°	′	″	°	′	″
D'Entrecasteaux Is.,						
— Trobriand Islands, Cape Denis . . .	8	24	0	151	4	40
— North Island . .	8	18	0	150	50	0
Laughlan Is., S. end	9	20	0	153	40	0
Jones's Islands,						
— Pocklington's Reef, South end . . .	10	53	0	155	3	0
Stephen s Island . .	0	22	0	137	29	0
Tiger Island . . .	1	45	0	142	0	0
Matty Island . . .	1	33	40	143	12	30
Durour Island . . .	1	46	0	142	56	0
Exchequer or Bougainville's I., S. end	1	40	30	144		0
The Hermits, N.E. end	1	28	30	145	7	0
Commerson Island .	0	45	0	145	15	0
Anchorites Is., S. end	0	54	0	145	30	
Sidney's Shoal . .	3	20	0	146	50	0
Admiralty Islands,						
— Grand I., N.W. Pt.	1	57	0	146	35	0
South East Point .	2	16	0	147	18	0
— Negro Is., N.E. end	1	58	50	147	16	50
— Purdy's Is., E. end	2	50	0	146	15	0
— Elizabeth Island .	2	55	0	146	49	0
— Jesus Maria Island, South East Point .	2	22	0	147	48	0
— Vandola Island .	2	14	0	148	10	0
— Raphael Island .	2	5	0	147	42	0
— Circular Reef . .	3	18	0	147	40	0
Portland Is., N. E. Pt.	2	36	0	149	38	45
Mathias Island . .	1	32	0	149	30	0
Squally Island . .	1	39	0	150	30	0
New Hanover Island,						
— North Point . .	2	22	0	150	0	0
— Q. Charlotte's C. .	2	31	0	149	50	0
Byron or Mausoleum Island	2	44	30	150	31	0
Sandwich I., peak .	2	55	0	150	44	0
New Ireland,						
— Cape Byron . .	2	46	0	150	33	0
— Point Hunter . .	4	37	0	152	38	0
— Port Carteret . .	4	39	0	152	43	0
— Port Gower or Praslin	4	47	45	152	48	29
— Cape St. George .	4	51	0	152	48	15
— Cape St. Mary .	4	2	0	153	18	0
— Slinger's Bay . .	3	10	0	152	0	0
Fisher's I., N. W. Pt.	2	32	0	152	12	0
Day's or Deny's I. .	3	10	0	152	45	0
Oraison Island . .	3	30	0	153	28	0
St. John's Island . .	3	52	0	154	0	0
Sir Charles Hardy's I.	4	41	0	154	20	0
Fead Islands, N. end	3	9	0	154	22	0
— Goodman's Island	3	27	0	154	45	0
— Bank	3	33	0	154	37	0
Lyras' Shoal, mid. .	1	53	0	153	28	0
New Britain,						
— Cape Stephens .	4	0	0	152	0	0
— Cape Palliser . .	4	27	0	152	14	0
— Cape Buller . .	5	8	0	152	9	0
— Cape Orford . .	5	34	0	152	4	0
— Port Montague .	6	6	0	150	30	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(85) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	New Britain,						
	— South Point . .	6	28	0	149	32	0
	— Cape Ann . . .	5	49	0	148	24	0
	— Cape Glocester .	5	28	20	148	25	0
	— Cape Raoult . .	5	27	0	148	55	0
	— Cape Lambert . .	4	12	0	151	41	0
	Isle of Man . . .	3	56	0	151	56	0
	Duke of York's Island,						
	— Port Hunter . .	4	7	30	152	10	0
	Duportail Island . .	4	56	0	151	17	0
	Willaumez Island,						
	— South Point . . .	5	15	3	149	59	45
	Raoult Island . . .	5	21	0	149	57	0
	Merite Island . . .	4	54	0	149	4	40
	North Island . . .	4	31	0	149	4	40
	Sir G. Rooke's Island,						
	— South East Point .	5	50	0	147	56	0
	— North West Point	5	25	0	147	44	0
	Volcano Island . .	5	32	0	148	4	0
	Crown Island, mid. .	5	15	0	147	20	0
	Long Island, S. Point	5	50	0	147	0	0
	—						
	Bouka Island, N. Pt.	5	0	30	154	35	0
	Bougainville Island,						
	— Cape Laverdy . .	5	32	0	154	55	0
	— Cape Le Cras . .	5	54	0	155	5	0
	— Cape Friendship .	6	45	0	155	42	0
	Shortland Island,						
	— Cape Stephens .	7	10	0	155	40	0
	Treasury Is., largest .	7	23	30	155	29	15
	New Georgia,						
	— Cape Cornwallis .	6	36	0	156	20	0
	— Cape Alexander .	6	48	0	156	4	0
	— Choiseul Bay, ent.	7	0	0	156	3	0
	— Cape Fleurieu .	7	33	0	157	13	0
	— Cape Labé . . .	7	15	0	157	14	0
	— Cape Allen . .	7	28	0	156	14	0
Salomon's Archipelago.	— Cape Middleton .	7	44	0	156	26	0
	Cape Satisfaction,						
	— Eddystone Island	8	18	0	156	30	40
	Cape Deception . .	8	41	0	157	19	30
	Cape Pleasant . . .	8	45	0	157	35	30
	Cape Nepean . . .	8	51	30	157	48	45
	Cape Pitt	8	53	0	158	14	30
	Bridgewater Reef .	8	54	0	157	12	0
	Princess Island . .	9	5	0	157	6	0
	Manning Strait . .	7	38	0	157	30	0
	Ysabel Island,						
	— Cape Comfort . .	7	15	0	157	45	0
	— Port Praslin . .	7	25	0	157	56	0
	— Estrella Bay . .	7	48	0	158	44	0
	— Cape Freycinet .	8	25	0	159	5	0
	Nairn Island . . .	7	42	0	157	52	0
	Ortega Island . . .	8	10	0	159	22	0
	Murray's Island . .	9	3	0	158	50	0
	Cape Marsh . . .	9	6	0	159	8	0
	Guadalcunar Island,						
	— Cape Esperance .	9	16	30	159	45	35
	— Cape Hunter . .	9	49	30	159	57	0
	— Cape Henslow .	9	59	0	160	39	0
	— North East Cape .	9	49	15	160	53	0
	Ramos Islands . . .	8	23	0	160	4	0

	(86) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Gower's Island . .	7	56	0	160	28	0
	Carteret I., N.W. Pt.	8	23	0	160	31	0
	Arsacedes I., S. Pt. .	9	8	0	161	22	0
	Contrariety or Smith's Island	9	48	0	162	8	10
	Three Sisters, mid. .	10	12	0	162	0	0
	San Christoval Island,						
	— C. de la Recherche	10	12	30	161	22	0
	— Cape Philip . .	10	33	0	161	32	0
	— Cape Sidney . .	10	48	0	161	50	0
Salomon's Archipelago.	— Cape Surville or Oriental	10	50	0	162	22	0
	Deliverance Islands,						
	— Sta Anna . .	10	51	0	162	28	0
	— Sta Catalina . .	10	53	10	162	26	30
	Bellona Bank . . .	11	11	0	159	50	0
	Rennell Is., S. E. Pt	11	38	0	160	41	0
	Well's Reef . . .	12	20	0	158	43	0
	Pandoras' Reef, N. end	12	6	0	160	34	0
	Indispensable Reef, S. end	12	46	0	160	42	0
	Green or Shortland I.	4	50	0	155	15	0
	Cocos Isles . . .	4	36	0	156	30	0
	Mortlock Island . .	4	45	0	157	0	0
	Ontong Java Islands,						
	— Port Princessa, ent	4	50	0	156	49	0
	Lord Howe's Group .	5	30	0	159	20	0
	Candelaria Shoals .	6	15	0	159	14	0
	Bradley's Shoals . .	6	32	0	161	0	0
	Stewart's Islands . .	8	26	0	163	6	0
	—						
	Low Islands . . .	10	11	0	165	37	0
	Swallow Island . .	10	13	0	166	32	0
	Duff's Group . . .	9	57	0	167	0	0
	Volcano Island . .	10	24	0	165	45	0
Charlotte's or Santa Cruz Islands.	Santa Cruz or Tomarico Island,						
	— Cape Byron . .	10	41	0	166	4	30
	— Cape Boscowen .	10	51	15	165	43	35
	— Cape Mendana .	10	54	0	165	50	0
	— Cape Barrington .	10	49	0	166	2	0
	Guerta Island . . .	10	40	0	165	45	30
	Lord Howe's Island .	10	49	0	166	1	0
	Edgecumbe or Paiou Island,						
	— North Point . .	11	15	15	166	28	0
	Oury or Whanoo I.,						
	— West Point . .	11	22	0	166	31	30
	Recherche or Pitt's I.	11	40	0	166	45	0
	Tucopia or Barwell's Island	12	15	0	169	50	0
	Cherry Island . . .	11	35	0	170	20	0
	Mitre Island . . .	11	55	0	170	0	0
	Pandoras Reef . .	12	11	0	172	0	0
	—						
	North Rocks . . .	13	16	0	168	58	0
	Bank's Islands,						
	— Sugar Loaf Island	13	52	0	169	4	0
	Blith or Torres I. .	13	29	0	167	52	0
	Star Island	14	22	0	168	8	0
	Espirito Santo Island,						
	— Cape Cumberland	14	38	45	166	49	30

TABLE LVI.

LATITUDES AND LONGITUDES.

	(87) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Espirito Santo Island,						
	— Cape Quiros . .	14	56	0	167	14	0
	— Port Vera Cruz .	15	15	0	167	8	0
	— Cape Lisburne .	15	40	0	166	59	0
	Bartholomew's Island	15	42	0	167	24	0
	Leper's Island . .	15	22	0	168	0	0
	Aurora Island, N. Pt	14	53	0	168	16	0
	Whitsun Island, S. Pt.	15	59	0	168	28	0
	Ambrym Island, E. Pt.	16	19	0	168	30	0
	Paoom Island . . .	16	27	0	168	26	0
	Mallicolo I., N.W. Pt.	15	51	0	167	23	0
	— Port Sandwich .	16	25	20	167	57	20
New Hebrides.	Maskelyne Islands .	16	32	0	168	0	0
	Johnston's Islands .	16	53	20	169	31	30
	Apee Island, mid. . .	16	43	0	168	30	0
	Shepherd's Is., largest	16	54	0	168	46	0
	Monument Island . .	17	0	0	168	50	0
	The Three Hills . .	17	3	0	168	34	0
	The Two Hills . . .	17	14	0	168	37	0
	Montague Island . .	17	26	0	168	32	0
	Hinchinbroke Island .	17	32	0	168	42	0
	Sandwich Island, S. Pt.	17	52	0	168	50	0
	Erromango Island,						
	— Traitor's Head . .	18	46	0	169	28	0
	Tanna Island, N. Pt.	19	20	0	168	30	0
	— Port Resolution .	19	32	25	169	44	30
	Var. 7° 14′ E.						
	Erronam Island . .	19	31	0	170	20	0
	Annatim Island . .	20	3	0	170	4	0
	—						
	Huon Is., N. Reef .	17	57	0	162	41	0
	Point Tonnere . . .	20	24	0	164	0	0
New Caledonia.	Port St. Vincent . .	22	0	10	165	55	0
	Cape Prince of Wales	22	29	0	166	42	0
	Q. Charlotte's Cape .	22	16	0	166	52	0
	Cape Colnet . . .	20	29	0	164	44	0
	Balade Harbour . .	20	17	25	164	27	0
	Beaupre's Islands. .	20	15	30	166	6	0
	Isle of Pines . . .	22	38	0	167	20	0
	Southern Reef . . .	23	5	0	166	49	0
	—						
	Durand's Reef. . .	22	6	0	169	2	0
	Walpole's Island . .	22	40	0	169	15	0
	Matthew's Island . .	22	22	0	171	15	0
	Hunter's Island . .	22	27	0	171	50	0
	New Shoal	20	55	0	160	31	0
	Low Islands . . .	21	21	0	159	20	0
	Lamb's Island . . .	21	24	0	158	30	0
	Baring's Shoal, N. end	20	40	0	158	40	0
	— South end . . .	21	50	0	159	30	0
	Booby Shoal . . .	21	0	0	159	6	0
	Minerva Shoal . .	20	40	0	159	30	0
	Bellona Shoals . .	20	54	0	159	50	0
	Ball's Rocks . . .	21	0	0	160	36	0
	Avon's Islands . .	19	31	0	158	10	30
	Bampton's Shoal,						
	— Chesterfield's Bank	19	51	0	158	20	0
	— North end . . .	18	49	0	158	43	0
	Kenn's Reef . . .	21	9	0	155	49	0
	Mellish Keys, S. end	17	16	0	156	12	0
	Young's Reef, S. end	17	17	0	155	20	0
	Wreck Reef, Bird I.	22	11	23	155	18	50

	(88) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Cato's Bank . . .	23	6	0	155	23	0
	Midday Reef . . .	21	58	0	154	20	0
	Frederick's Reef,						
	— N. E. end . . .	20	44	0	154	25	0
	Saumarez Shoal . .	21	40	0	153	46	0
	Welsh's Bank . . .	21	15	0	153	56	0
	Horseshoe Bank,						
	— North end . . .	20	5	0	151	50	0
	Alert's Reef . . .	17	2	0	151	49	0
	Diana's Shoal . . .	15	41	0	150	25	0
	Lihou's Reef . . .	17	25	0	151	45	0
	Farquhar's Groupe,						
	— West end . . .	17	39	0	151	27	0
	Vine's Bank . . .	17	45	0	151	40	0
	Tregosse Is., E. end .	17	44	0	150	32	0
	Middleton's Island .	28	13	0	160	31	0
	Middleton's Shoals .	29	14	0	158	54	0
	Golden Grove Shoal .	29	30	0	160	0	0
	Elizabeth's Reef . .	30	5	0	159	0	0
	Lord Howe's Island .	31	26	0	159	0	0
	Ball's Pyramid . .	31	43	0	159	5	0
	Rock	26	6	0	160	0	0
	Island	31	19	0	160	42	0
	Rock	23	48	0	164	15	0
	Norfolk Island . . .	29	2	0	168	2	0
	Var. 11° 0′ E.						
	Three Kings Islands .	34	12	8	172	22	48
	—						
	Northern Island,						
	C. Maria Van Diemen	34	29	49	172	48	58
	North Cape. . . .	34	24	29	173	9	48
	Bay of Islands,						
	— Kororadicca . .	35	15	45	174	15	55
	Bream Head . . .	35	51	30	174	46	0
	Cape Rodney . . .	36	20	26	174	56	0
	River Thames,						
	— Bottom, in 4 fms. .	37	5	45	175	25	30
	Cape Colville . . .	36	26	0	175	27	0
	Mercury Bay, anchge.	36	50	13	175	51	0
	White Island, Volcano	37	30	46	177	14	45
	Mount Edgecumbe	37	59	0	176	56	0
New Zeeland Islands.	Cape Runaway .	37	32	0	177	52	0
	Cape East	37	44	30	178	36	15
	Tolaga Bay	38	22	0	178	22	0
	Young Nick's Head .	38	43	30	178	0	19
	Table Cape	39	6	0	178	0	0
	Portland Isle . . .	39	22	0	177	38	0
	Cape Kidnapper . .	39	43	0	177	6	0
	Cape Turnagain . .	40	35	0	176	38	0
	Cape Palliser . . .	41	34	46	175	24	45
	Cape Tearawitte . .	41	18	47	174	42	45
	Cape Egmont . . .	39	23	30	174	2	0
	Jokeehangar River,						
	— South Head . .	35	32	3	173	31	45
	— North Head . .	35	31	22	173	31	45
	Var. 13° 20′ E.						
	False Inlet	35	17	19	173	22	17
	Southern Island,						
	Cape Farewell . . .	40	34	42	173	30	0
	Cape Stephens . . .	40	39	0	174	0	0
	Q. Charlotte's Sound,						
	— Port Jackson . .	40	58	45	174	23	30

TABLE LVI.

LATITUDES AND LONGITUDES.

	(89) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	Q. Charlotte's Sound,						
	— Ship Cove . . .	41	5	56	174	13	0
	Var. 15° 9′ *E.*						
	— Cape Koamaroo .	41	6	5	174	29	15
	Cape Campbell . .	41	33	16	174	15	0
	Bank's Peninsula,						
	— South Point . . .	43	52	15	173	0	0
New Zeeland Islands.	Dangerous Reef . .	45	24	26	170	50	0
	Port Otago or Oxley .	45	46	28	170	36	45
	Cape Saunders . . .	45	53	55	170	33	30
	Cape West	45	54	0	166	10	0
	Dusky Bay,						
	— Port Pickersgill .	45	47	26	166	18	0
	Var. 13° 49′ *E.*						
	— Anchor I., Harbour	45	44	15	166	15	54
	Solander Island . .	46	31	45	166	33	36
	Stewart's Island,						
	— Cape South West	47	16	37	167	14	30
	— Southern Port,						
	Cable Island . .	47	12	55	167	26	30
	Var. 16° 54′ *E.*						
	Traps, North end . .	47	23	7	167	42	30
	Snares, N. E. Island .	48	3	48	166	20	15
	——						
	Macquarie's I., N. end	54	38	0	159	45	0
	— Caroline Cove . .	54	52	0	159	35	0
	Var. 8° 56′ *E.*						
	Bishop and Clerks .	55	14	0	159	44	0
	Judge and Clerks . .	54	20	0	160	2	0
	Royal Company's I. .	49	40	0	142	10	0
	Ld. Auckland's Group,						
	— North West Cape	50	31	0	166	0	0
	— South East Cape .	50	53	0	166	17	0
	— Disappointment I.	50	38	30	165	52	0
	— Endersby I., N. Pt.	50	32	30	166	28	0
	— Bristow's Rock .	50	22	0	166	21	0
	Campbell's I., mid. .	52	32	0	169	30	0
	Var. 12° 0′ *E.*						
	Penantipode Island .	49	40	0	179	40	0
	Bounty Islands . .	47	50	0	178	25	0
	Chatham Island,				West		
	— Cape Young, N.Pt.	43	46	0	176	14	0
	— Cape Munnings,						
	N. E. Point . . .	43	50	0	175	40	0
	— Point Allison,						
	N.W. Point . . .	43	55	0	176	34	0
	— Skirmish Bay . .	43	49	0	175	48	0
	Var. 14° 0′ *E.*						
	Cornwallis I., S. end	44	36	30	175	25	40
	Nimrod's Group . .	56	30	0	158	30	0
					East		
	Rosaretta Shoal . .	30	10	0	173	45	0
	Kermadee Islands,				West		
	— Raoul I., N.W. Pt.	29	16	45	178	5	0
	— Macauley Island .	30	16	0	178	32	0
	— Curtis's Islands .	30	36	15	178	43	30
	— L'Esperance, or						
	Brind's Rock . .	31	27	30	178	55	0
	——						
	Fidgee Islands,				East		
	— Paoo I., N. Point	16	16	0	179	0	0
	East Point . . .	16	50	0	179	32	0

	(90) Places.	Lat. S.			Lon. E.		
		°	′	″	°	′	″
	— Paoo Island,						
	Sandalwood Bay .	16	30	0	178	30	0
	— Navihilivoo Island,						
	North Point . . .	17	28	0	178	0	0
	South East Point .	18	2	0	178	19	0
	— Mywoolla Island,						
	S. W. Point . . .	19	10	0	178	5	0
	— Eliza's Reef, N. end	18	0	0	179	20	0
					West		
	— Turtle Island . .	19	48	45	178	0	0
	— Providence Reef .	18	30	0	178	0	0
	— Duff's Reef . . .	16	30	0	179	17	0
	— Scylla Reef . . .	16	5	0	179	36	0
	— Farewell Island .	15	42	0	179	35	0
	Tonga Islands,						
	— Ono Island . . .	20	39	0	178	45	0
	— Coral Reef . . .	20	45	0	178	53	45
	— Two Small Islands	21	2	45	178	48	0
	— Pylstaart Island,						
	S.W. Point . . .	22	24	45	175	57	0
	— Eoua I., English Rd.	21	20	30	174	57	30
	— Tongataboo, Obs. .	21	8	19	175	10	15
	— Culebra's Bank .	20	21	0	175	16	0
	— Annamocka . .	20	15	0	174	56	20
	— Kotou Island . .	19	58	0	174	55	0
Friendly Islands.	— Toufoa	19	46	0	175	10	0
	— Koa	19	42	0	175	8	0
	— Hapaee Islands,						
	Lafagoo	19	51	0	174	27	0
	— Latté Island . .	18	47	20	174	31	0
	— Vavao, Port Refuge	18	38	45	173	57	45
	— Amargura . . .	17	57	0	174	58	0
	Navigator's Islands,						
	— Pola or Oteewhy I.,						
	North East Point .	13	27	30	171	56	0
	South East Point .	13	45	0	171	51	30
	— Mananoo or Platte I.	13	51	15	171	47	40
	— Oahtooah or						
	Oyolava Island,						
	East Point . . .	14	2	40	171	7	15
	— Maouna or						
	Tootooillah Island,						
	West Point . . .	14	20	51	170	20	0
	Massacre Bay . .	14	20	45	170	17	0
	— Tabootaboo . . .	14	21	0	170	2	0
	— Fanfoué, E. Point	14	5	20	169	18	30
	— Leoné or Olooshonga	14	7	50	169	16	20
	— Opoun, E. Point .	14	9	10	169	9	50
	— Rose or Kordiucoff						
	Island	14	33	0	168	5	51
	Rotumah Island . .	12	31	0	177	15	E
	Onascuse or Hunter's				West		
	Island	15	31	0	176	11	0
	Horne Islands . . .	14	18	0	178	18	0
	Enfans Perdu . . .	14	21	0	176	40	0
	Wallis' Island . . .	13	22	0	176	4	0
	Boscawen Island . .	15	50	0	174	7	0
	Keppel's Island . .	15	56	30	174	10	24
	Onookfou or Proby I. .	15	53	0	175	51	0
	——				East		
	Charlotte's Bank . .	11	50	0	173	12	0

TABLE LVI.

LATITUDES AND LONGITUDES.

(91) Places.	Lat. S.			Lon. W.		
	°	′	″	°	′	″
Solitary Island	10	46	0	174	43	0
					East	
Independence or Ganges Island	10	25	0	179	0	0
Mitchell's Groupe,						
— Plaskett Island	9	18	0	179	50	0
Ellice's Group,						
— Escape Island	8	29	5	179	6	0
De Peyster's Groupe,						
— South end	8	5	0	178	17	0
Netherland Island	7	7	0	177	33	0
Island	7	25	0	179	28	0
Larose Island, S. end	7	19	0	176	55	0
Egg Islands	7	10	0	177	10	0
Sherson's or Cocal I.	6	1	48	176	27	3
Taswell's or Saint Augustine Island	5	38	0	176	9	50
Hope or Hurd Island	2	50	0	177	0	0
Jesus Island	6	45	0	171	30	0
Mattoelee or Kennedy Island	8	10	0	168	0	0
Shank's Island ?	0	25	0	163	0	0
Pleasant Island	0	25	0	167	10	0
Ocean Island	0	48	0	169	49	0
Doubtful Island	3	10	0	170	0	0
Rotche's Island	2	32	0	176	9	0
Eliza's Island ?	2	5	0	176	0	0
Arthur's Island	3	30	0	176	0	W.
Island	2	50	0	170	18	E.
					West	
Kemin Island	4	45	0	173	40	0
Rock	5	38	0	172	53	45
Island	3	41	0	172	52	0
Gardner's Island	4	30	0	174	22	0
Mary Letitia's Rock	4	46	0	173	19	0
Dangerous Reef	5	38	0	173	33	0
Elizabeth's Island	4	27	0	172	21	0
Sidney's Islands	4	28	0	171	21	0
Phenix Island	3	35	0	170	40	0
Burney's Island	3	30	0	171	20	0
Mary's Island	2	45	0	172	0	0
Enderby's Island	3	6	0	171	11	0
Farmer's Island	2	53	0	170	46	0
D. of York's Island	8	33	0	172	0	0
Duke of Clarence's I.	9	12	0	171	30	0
Quiros Island ?	10	40	0	170	6	0
Island	6	34	0	166	30	0
Rock	10	46	0	166	6	0
Danger Islands	10	15	0	165	58	0
Suwarrow Islands	13	20	0	163	30	0
Reirson's Island	10	6	0	160	55	0
Humphrey's Island	10	33	0	161	0	0
Bennett's Island	8	54	0	159	45	0
Jarvis's Island	0	24	0	159	58	0
Piscado Island	10	36	0	159	25	0
Penrhyn's Islands	9	1	30	157	34	30
Var. 8° 28′ *E.*						
Starve Island	5	43	0	156	30	0
Maldon Island	3	58	30	154	58	0
Starbuck Island	5	24	0	155	50	0
Independance Island	4	10	0	154	30	0
Bunker's Rock	0	17	0	160	40	0
Broke Island	1	13	0	159	30	0

	(92) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
	Island	6	45	0	160	48	0
	Bauman's Islands	11	54	0	155	10	0
	Flint's Island	11	20	30	151	53	30
	Staver's Island	10	4	0	151	50	0
	Caroline's Island	9	57	0	150	25	0
	Vasquez Island	24	44	0	175	18	0
	Savage Island	19	1	0	169	37	0
	Beveridge Reef	19	56	0	167	30	0
	Palmerston Island	18	4	0	163	10	0
	Cook's Islands,						
	— Whylootacke	18	54	0	159	41	0
	— Hervey's Island	19	18	0	158	54	0
	— Okatoolaiai Island	19	51	0	158	23	0
	— Mittiaro Island	19	55	0	157	54	0
	— Wateeo Island	20	1	0	158	15	0
	— Mawti Island	20	8	0	157	20	0
	— Mahowara Island	20	15	0	157	57	0
	— Rorotonga or Orurute Island	21	20	0	160	0	0
	— Roxburgh Island	21	36	0	159	18	0
	— Mongeea Island	21	57	0	158	7	0
	——						
	Island	26	0	0	160	59	0
	Bellinghausen's Island	15	48	0	154	30	0
	Scilly Islands	16	28	0	155	30	0
	Mopeelia Island	16	46	0	154	8	0
	Tabae Island, N. Pt.	16	11	0	151	48	0
	Maurua Island	16	25	0	152	8	20
	Bolabola Island	16	27	0	151	46	20
	Otaha Island	16	35	0	151	35	0
Society Islands.	Ulieta Island,						
	— Port Ohamaneno	16	45	32	151	36	20
	Huahene Island,						
	— Port Owharre	16	42	49	151	7	36
	Saunders Island	17	28	0	150	40	50
	Eimeo Island,						
	— Port Talou	17	30	0	150	0	0
	Otaheite Island,						
	— Point Venus	17	29	12	149	28	46
	Var. 6° 50′ *E.*						
	— Oiatipeha Hr.	17	46	28	149	7	20
	Tethuroa Island	17	6	0	149	33	35
	Maitea or Osnaberg Island	17	49	10	148	3	20
	——						
	Peregrino Island	14	42	0	151	42	0
	Fugitive Island	15	30	0	150	52	0
	Recreation Island	15	31	0	150	0	0
	Lazaroff Island	14	56	0	149	10	0
Low Islands.	Krusenstern's Islands	15	0	0	148	45	36
	Matia Island	15	52	30	148	18	30
	Deans Islands, W. end	15	0	0	148	27	30
	— East End	15	16	30	147	12	0
	Labyrinth Island	15	38	0	148	31	0
	Rurick's Is., W. end	15	20	0	146	57	0
	— East End	15	20	0	146	35	30
	King George's Islands						
	— Twokea	14	37	0	145	15	30
	— Oura	14	41	0	145	5	26
	Romanzoff Island	14	57	20	144	28	3
	Carlshoff Island	15	27	0	145	31	12
	Elizabeth Island	15	56	0	146	0	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(93) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
	Palliser Island	15	34	25	146	6	50
	Two Small Islands	15	30	0	146	20	50
	Greig's Island	16	11	0	146	22	0
	Wittgenstein Islands, — North end	16	1	0	145	39	0
	MyloradowitchIsland — North end	16	42	0	145	19	0
	Tchitchagoff Islands, — West end	16	52	0	144	58	0
	Sackin I., S. E. end	16	31	0	144	12	0
Low Islands.	Adventure, or Guarava Island	17	4	0	144	30	0
	Chain Island	17	26	0	145	38	0
	Philip's Island	16	34	0	143	57	0
	Koutousoff Island	16	36	0	143	45	30
	Jermoeloff or Holt's I.	16	21	45	143	9	20
	Fourneaux Island	17	5	0	143	16	0
	St. Quintin's Island	17	20	0	143	48	0
	Bird Island	17	48	0	143	10	0
	Bunyer's Group	18	12	0	143	20	0
	Wolchonsky Island	15	52	0	142	14	0
	Barclay de Tolly I.	16	13	0	142	29	0
	Nigeri Island	17	42	0	142	48	0
	Doubtful Island	17	20	0	142	38	0
	Two Groups	18	12	0	142	17	0
	Lostange I., E. Point	18	43	0	141	48	45
	Pr. Wm. Henry's I.	19	13	50	141	17	0
	Resolution Island.	17	24	0	141	39	0
	Disappointment Is.	14	6	0	140	58	0
	Dogs' Island	14	50	0	138	52	30
	Arackchiff Island	15	51	0	140	52	0
	Enterprize, or Predpriatre Island.	15	58	15	140	11	30
Dangerous Archipelago.	Moller, or Freycinet's Island, — North East Point.	17	43	0	140	37	0
	Bow Island, N. E. Pt.	18	6	0	140	57	0
	Glocester Island	19	11	0	140	15	0
	Cumberland Island	19	18	0	140	47	0
	Narcissus Island	17	25	0	139	15	0
	Island	16	0	0	139	0	0
	David Clerk's Island.	17	19	0	138	30	0
	Thrum Cap Island	18	30	0	139	8	0
	Lagoon Island	18	43	0	138	47	0
	Egmont Island	19	24	0	139	14	0
	Q. Charlotte's Island	19	18	0	138	42	0
	Whitsun or Trinity I.	19	24	0	138	37	0
	Shoal	19	30	0	137	30	0
	Serle's I., N. W. Pt.	18	18	15	136	58	15
	Minerva, or Tonnere I., S. E. Pt.	18	33	0	136	1	30
	Remitara Island	22	43	0	152	3	0
	Ohetiroa Island	22	27	0	150	46	45
	Toobouai Island	23	25	0	149	23	0
	Vavitoo Island	23	42	0	147	11	0
	Oparo Island	27	36	0	144	8	32
	Bass Islands	27	40	0	143	30	0
	Glocester Islands	20	38	0	143	7	30
	Surrey Island	19	56	0	145	6	0
	St. Elmo Island	21	20	0	143	50	0
	St. Michael's Island	20	9	0	144	0	0

	(94) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
	St. Paul's I., W. Pt.	19	46	0	145	5	0
	Margaret's Island.	20	26	0	143	24	0
	Blyth's Island	21	38	0	140	38	0
	Carysfort I., E. end	20	44	50	138	19	30
	Osnaburg I., E. end	21	50	30	138	44	30
	Duff's or High Island	20	30	0	136	40	0
	Lord Hood's Island	21	30	50	135	33	0
	Gambier's Islands.	23	8	20	134	55	20
	Crescent Island	23	20	30	134	35	0
	Washington Islands, — Fattouhou Island, N. E. Point	7	50	0	140	6	0
	— Hiaou I., S. Point	7	59	0	140	13	0
	— Mottuaity Island.	8	37	30	140	20	0
	— Noukahua Island, Point Martin	8	57	0	139	32	30
Mendana Islands.	Point Anna Maria.	8	55	30	139	30	45
	Point Tchitchagoff	8	57	0	139	42	15
	— Ouahouga, or WashingtonIsland, South Point.	8	58	15	139	13	0
	— Ouapoa I., N. Pt.	9	21	30	139	39	0
	— Lincoln Island.	9	29	30	139	33	30
	Marquesas, — Tetugoa Island	9	24	30	138	29	30
	— OhevahoaI., W.Pt.	9	44	0	138	51	0
	East Point	9	42	0	138	32	0
	— Taowatte Island, Resolution Bay.	9	55	30	138	50	10
	— Motane Island.	9	57	0	138	32	0
	— Ohitaheooh, or Magdalen Island	10	25	0	138	28	0
	St. Juan Baptista I.	24	0	0	139	0	0
	Incarnation Island	24	45	0	136	40	0
	Martha's Island	24	3	0	131	20	0
	Oeno or Bond's Island	23	57	0	131	5	0
	Pitcairn's Island	25	4	0	130	9	30
	Henderson's Island	24	21	0	128	20	0
	Elizabeth's Island	24	26	0	127	50	0
	Ducie's Low Island	24	40	0	124	46	0
	Easter I., Cook's Bay	27	9	30	109	25	20
	Salas y Gomez Island	26	27	15	105	20	30
	Pilgrim's Island	24	40	0	104	40	0
	St. Felix Island	26	20	15	80	10	0
	Ambrose Island	26	20	0	79	51	0
	Var. 11° 30′ *E.*						
	Juan Fernandez Is., — Afuera	33	49	0	80	34	0
	— Tierra, S.W. Point	33	45	0	78	51	43
	Peter the 1st Island	68	57	0	90	46	0
	Alexander the 1st I.	68	13	0	73	10	0

XXIII. The WEST COAST of AMERICA, from CAPE HORN to ICY CAPE.

Places	°	′	″	°	′	″
CAPE HORN	55	58	40	67	12	25
Var. 22° 30′ *E.*						
Diego Ramirez Is.	56	26	30	68	37	0
St. Ildefonso Islands	55	51	0	69	10	30

TABLE LVI.

LATITUDES AND LONGITUDES.

	(95) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
T. del Fuego.	Christmas Sound,						
	— York Minster	55	24	30	70	2	30
	Adventure Cove	55	21	12	69	50	35
	Doris Cove, E. Pt.	54	53	40	71	6	10
	Cape Noir or Negro	54	31	30	73	16	15
	Cape Gloucester	54	7	0	73	36	0
	Cape Pilar	52	46	0	74	54	15
	The Evangelists	52	34	0	75	6	0
	Cape Victory	52	23	0	74	56	0
	Cape Sta. Lucea	51	25	0	75	31	0
	Cape St. Jago	50	54	0	75	32	0
	Var. 21° 30′ *E.*						
	Cape Three Points	49	46	0	75	46	15
	Cape Corso	49	26	0	75	46	0
	Guayanceo Is. N. Pt.	47	32	0	75	5	0
	Cape Tres Montes	46	59	0	75	28	0
	Lemus I., N. Point	45	6	0	74	47	0
	Guaytecas Is., W. Pt.	44	25	0	74	0	0
	Guafo Island, middle	44	1	0	74	39	0
	Chiloe Island,						
	— Point Quelan	43	41	0	74	19	30
	Var. 16° *E.*						
	— Castro	42	41	0	73	36	0
	— St. Carlos, Fort	41	51	50	73	53	50
	Point Quedal	41	5	0	74	5	0
	Valdivia, Fort	39	50	7	73	34	35
	Mocha I., middle	38	20	0	74	5	0
	Sta Maria I. N.W. Pt.	37	1	0	73	41	0
	Arauco	37	14	30	73	28	30
	Conception, City	36	49	10	73	4	45
	Port Conception,						
	— Talcahuano	36	42	32	73	8	0
Coast of Chili.	*Var.* 15° 30′ *E.*						
	Itata River, entrance	35	58	0	72	52	0
	Topocalma Shoal, mid.	33	55	0	71	56	20
	St. Jago, City	33	26	30	70	44	0
	Valparaiso,						
	— Rosario Castle	33	1	55	71	40	25
	Var. 14° 43′ *E.*						
	Rio Limari, entrance	30	45	0	71	52	0
	Punta de Lengua de Baca	30	16	30	71	46	0
	Port Coquimbo,						
	— La Serena, Church	29	53	43	71	18	40
	Canaveral Island	29	2	0	71	39	0
	Port Guasco, Outer Rock	28	27	0	71	14	0
	Var. 13° 30′ *E.*						
	Copiapo	27	20	0	71	6	0
	Nostra Senora Bay,						
	— North Point	25	12	0	70	48	0
	George's Hill	23	31	0	70	34	0
	Mexillones Hill	23	3	0	70	27	0
	Cobija	22	29	30	70	6	0
	Tarapaca Hill	20	17	0	70	17	0
	Iquique Island	20	13	15	70	13	0
	Pesagua Point	19	27	0	70	19	0
	Arica, St. Mark	18	28	35	70	16	0
	Var. 10° 25′ *E.*						
	Ilo	17	36	15	71	19	0
	Mollendo	17	2	15	71	54	0
	Port Ilay	17	1	0	72	0	15

	(96) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
	Quilca	16	41	50	72	27	15
	Pescadores	16	15	10	73	33	51
	Port Caballos,						
	— Point Nasca	14	58	50	75	23	57
	Infernal Rock	14	42	5	75	44	33
	Mercedes Hill	14	35	29	76	3	48
	Los Amigos	14	20	0	76	7	16
	Sangallan Island	13	50	0	76	25	0
	Pisco	13	44	0	76	13	0
	Canete, Point Frayle	13	3	0	76	31	0
	Chilca Point	12	33	0	76	46	0
	Morro Solar	12	12	0	76	59	0
	Lorenzo I., N. Point	12	4	0	77	12	0
	Callao, Castle	12	3	45	77	6	10
	Var. 10° 34′ *E.*						
	LIMA, City	12	2	34	76	58	45
	The Hormigas or Ants	11	55	48	77	51	17
	Pescador Island	11	46	0	77	12	30
	Huauca Point	11	19	0	77	30	0
	Patibilea, Road	10	51	0	77	32	0
	Guarmay R., entr.	10	4	0	78	6	0
	Santa Island	9	1	30	78	36	0
	Guanape Island	8	36	0	78	55	0
	Truxillo	8	6	0	78	56	0
	La Campana Hill	7	57	30	79	0	0
	Malabrigo Point	7	45	30	79	19	0
	Pacasmayo Point	7	28	40	79	28	0
Coast of Peru.	Cherrepe Hill	7	11	40	79	29	0
	Eten Hill	6	56	10	79	45	0
	Lobos de Afuera	7	3	0	80	41	0
	Lobos de Tierra	6	30	0	80	48	0
	Aguja Point	5	59	20	81	4	0
	Piura River	5	33	0	80	48	0
	Payta Point	5	3	30	81	2	0
	Parina Point	4	42	30	81	11	0
	Cape Blanco	4	19	30	81	7	0
	Picos Point	3	45	10	80	36	30
	St. Clara Island	3	13	42	80	14	33
	Point Salinas	3	4	0	80	8	0
	Guayaquil	2	12	12	79	39	46
	Var. 9° 5′ *E.*						
	St. Elena Point	2	11	0	80	48	0
	Salango Island	1	38	0	80	41	0
	Island de la Plata	1	18	45	80	56	0
	Cape St. Lorenzo	1	4	0	80	43	0
	Cape Pasado	0	23	0	80	20	0
	QUITO, City	0	13	17	78	21	30
		North					
	Cape St. Francisco	0	39	0	79	52	0
	Galera Point	0	48	0	79	50	45
	Esmeraldas	0	54	0	79	23	0
	Point Mangles	1	36	30	78	50	30
	Tumaco Island	1	47	0	78	38	0
	Gallo Island	1	57	0	78	31	0
	Point Guascama	2	29	0	78	21	0
	Gorgona Island	2	52	30	78	4	0
	Buenaventura Bay	3	50	0	76	55	0
	Magdalena Bay	3	56	0	77	5	0
	Chirambira Point	4	14	30	77	15	0
	Cerro de Baudo	4	49	0	76	56	0
	Cape Corrientes	5	34	0	77	16	0
	St. Francisco Solano Pt.	6	48	30	77	48	30

TABLE LVI.

LATITUDES AND LONGITUDES.

(97) Places.	Lat. N.			Lon. W.		
	°	′	″	°	′	″
Quemado Hill . . .	7	18	0	77	50	0
Port Penas	7	32	0	77	52	0
Garachiné Point . .	8	6	30	78	10	15
Isla del Rey,						
— Cocos or S. Point .	8	13	0	78	40	0
PANAMA, City . . .	8	57	30	79	18	30
Var. 7° 0′ *E.*						
Chamé Point . . .	8	38	35	79	28	30
Point Mala	7	25	0	79	54	0
Point Mariato . . .	7	14	0	80	36	0
Quicara Islands, S.end	7	10	0	81	40	0
Quibo Isle,						
— Port Damas . .	7	26	0	81	31	0
Burica Point . . .	8	1	0	82	50	0
Cape Blanco . . .	9	30	0	84	35	0
Mount Hermosa . .	10	11	0	85	25	0
Central America.						
Port Culebra, entr. .	10	42	0	85	37	0
St. Catalina Point .	10	54	0	85	47	0
Leon	12	20	0	86	45	0
Realejo	12	29	50	87	6	30
Point Remedios . .	13	30	0	89	40	0
Nuevo Guatemala .	14	7	0	91	20	0
Barra de Soconusco .	15	35	0	93	22	0
Tchuantepic . . .	16	13	0	95	24	0
Palizada or Acamama	16	33	0	98	54	0
Acapulco, Fort. . .	16	50	29	99	53	47
Var. 8° 40′ *E.*						
Tetas de Telupan, abt	18	18	0	103	20	0
Cape Corrientes . .	20	24	32	105	42	26
Piedra Island . . .	20	43	0	105	51	4
St. Blas	21	32	24	105	18	27
Piedra Blanca . . .	21	34	48	105	32	7
Tres Marias Islands,						
— South Island . .	21	19	22	106	15	40
— St. Juanito Island	21	45	0	106	42	17
Isabella Island . . .	21	51	15	105	55	47
Gulf of California,						
— R. Mazatlan, entr.	23	10	30	106	35	0
— Port Guaymas. .	27	53	41	110	47	15
— Espirito Santo I. .	24	35	0	109	58	0
— Cape del Palmo .	23	23	0	109	15	0
— Cape San Lucas .	22	52	28	109	50	23
Todos los Santos . .	23	26	0	110	16	48
Morro Hermosa . .	27	46	0	114	41	0
Redondo Island . .	29	49	0	115	10	0
Bay St. Francisco .	30	23	0	115	36	0
Todos Santos Bay. .	31	56	0	116	22	0
Port Diego	32	42	30	116	53	15
Point Conception . .	34	32	0	120	6	0
Monterey	36	36	24	121	51	46
Port St. Francisco .	37	48	30	122	27	23
Cape Mendocino . .	40	29	0	124	29	0
Port Trinidad . . .	41	3	0	124	0	0
Cape Blanco or						
Orford	42	52	0	124	25	0
Cape Gregory . . .	43	29	0	124	9	0
Cape Perpetua . . .	44	12	0	123	55	0
Cape Foulweather .	44	49	0	123	56	0
Cape Lookout . . .	45	32	0	123	49	0
Colombia River,						
— C. Disappointment	46	19	0	123	54	0
Var. 20° 0′ *E.*						

(98) Places.	Lat. N.			Lon. W.		
	°	′	″	°	′	″
Gray's Harbour . .	47	0	0	123	53	0
Point Grenville . .	47	22	0	124	1	30
Cape Flattery . . .	48	23	30	124	22	0
——						
Vancouver's Island.						
Port St. Juan . . .	48	34	0	124	8	0
Nootka Sound . . .	49	34	20	126	28	30
Woody Point . . .	50	6	0	127	43	0
Cape Scott	50	48	0	128	20	0
Scott's or Sartine's						
Islands	50	52	0	129	0	0
Point Chatham . .	50	19	30	125	15	0
Pta. de Gonzalo . .	48	28	0	122	53	0
——						
Cape Caution . . .	51	12	0	127	51	0
Cape Swaine . . .	52	13	0	128	20	0
Calamity Harbour. .	53	10	30	129	34	0
Cape Ibbetson . . .	54	4	0	130	30	0
Brown's Passage . .	54	20	0	130	32	0
Cape de Chacon . .	54	43	0	131	45	0
Cape de Muzon . .	54	42	30	132	31	0
——						
Queen Charlotte's Island.						
Cape St. James or						
Hector	51	57	30	131	6	0
Cape Henry . . .	52	53	0	132	14	30
Mawko	53	2	0	132	5	0
Point Buck	53	10	0	132	40	0
Point Hunter . . .	53	19	0	132	47	0
Langara or						
North Island . . .	54	20	0	133	2	30
Point Estrado . . .	54	12	0	131	5	0
——						
Forrester's or						
St. Carlos Island,						
— North Point . .	54	53	0	133	21	0
Point Bucarelli . .	55	12	0	133	25	0
Cape Addington . .	55	26	45	133	37	30
Cape Pole	55	58	20	133	33	0
Cape Decision. . .	56	2	0	133	52	0
Hazy Islands . . .	55	54	0	134	18	0
Cape Ommaney . .	56	10	0	134	23	30
Norfolk Sound,						
— Cape Edgecumbe .	57	2	0	135	34	30
Cape Cross	57	55	30	136	17	0
Var. 30° *E.*						
Cape Spencer . . .	58	12	30	136	24	20
Cape Fairweather. .	58	50	40	137	55	0
Port des Francois. .	58	36	0	137	45	0
Behring's Bay . . .	59	7	20	138	24	0
Admiralty Bay,						
— Cape Phipps . .	59	33	0	139	54	0
Point Riou	59	54	0	141	30	0
Mount St. Elias . .	60	22	30	141	0	0
Cape Suckling . . .	60	1	0	143	42	0
Cape Hammond . .	59	48	30	144	26	0
Pr. William's Sound,						
— Cape Hinchinbroke	60	16	30	146	26	0
— Port Chalmers. .	60	16	0	147	5	0
Var. 28° 30′ *E.*						
— Cape Puget . .	59	54	30	148	15	0
Middleton's or Rose I.	59	32	0	146	22	0
Chiswell's Islands,						
— South Point .	59	31	0	149	24	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(99) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Cape Elizabeth . .	59	9	0	151	27	0
	Port Chatham . . .	59	14	0	151	14	0
Cook's Inlet.	*Var.* 24° 0′ *E.*						
	Anchor Point . . .	59	39	0	151	39	0
	East Foreland . . .	60	43	0	150	58	0
	West Foreland. . .	60	42	0	151	16	0
	Point Campbell . .	61	8	0	149	38	0
	Point Harriott . . .	60	24	0	151	48	0
	Cape Douglas . . .	58	52	0	152	50	0
	——						
	Point Banks . . .	58	40	0	152	6	0
Kodiak.	I. St. Hermogenes .	58	10	30	151	30	0
	Cape Grenville . .	57	34	30	152	0	0
	Port St. Paul . . .	57	46	50	152	18	0
	Cape Barnabas. . .	57	10	0	152	39	0
	Cape Trinity . . .	56	45	0	153	38	0
	——						
	Trinity Islands . .	56	33	30	153	36	0
	Tschirikoff I., N. Pt	55	54	0	155	8	0
	Schoomagen Islands,						
	— South Island . .	54	45	0	160	0	0
	Halibut Islands,						
	— Sannagh Island .	54	27	0	163	0	0
	Isanotzky Str., S.entr.	54	34	0	163	28	0
	——						
	Ounimack I.,N.W.Pt	54	45	0	165	10	0
	— N. E. Point. . .	54	50	0	163	35	0
	Oonalashka I.,S.W.Pt.	53	13	0	167	47	0
	— Port Illuluk . .	53	52	25	166	32	0
	Var. 19° 24′ *E.*						
	Oumanack I.,S.W.Pt.	52	51	0	168	50	0
	— N. E. Point . .	53	30	0	167	16	0
	Younaska Island, mid	52	40	0	170	15	0
	Tschegoula Island. .	52	40	0	170	34	0
	Amoughta Island . .	52	33	0	170	45	0
Aleoutian Archipelago.	Seguam Island, mid .	52	22	0	172	18	0
	Atcha Island, N.E.Pt.	52	32	0	173	40	0
	— West Point. . .	52	5	0	175	20	0
	Sitchin Island . . .	52	11	0	176	5	0
	Adach Island, N.E.Pt.	52	5	0	176	22	0
	Kanaga Island, N. Pt.	52	4	0	176	50	0
	Tanaga Island, Bay .	51	52	0	178	2	0
	— North Point . .	52	3	0	178	0	0
	Brulee Island . . .	51	56	0	178	40	0
	Amatignac Island. .	51	5	0	178	55	0
						East	
	Amtschitka I., W. Pt.	51	43	0	178	45	0
	— East Point . . .	51	34	0	179	40	0
	Rat Island	54	48	0	178	24	0
	Tschegoula Islands .	52	14	0	178	22	0
	Kiska Island, N. Pt. .	52	22	0	177	50	0
	Boulayr Island . .	52	42	0	176	13	0
	Semitsch Islands . .	53	6	0	174	0	0
	Agattou Island . .	52	43	0	173	38	0
	Attou I., E Point .	52	58	0	173	30	0
	— West Point. . .	52	58	0	172	17	0
	— Massacre Bay . .	52	50	0	173	12	0
	——						
	Bhering's Island,S Pt.	54	21	0	166	44	0
	— North Point . .	55	22	0	165	56	0
	Mednoi or Copper I.,						
	— North Point . .	54	52	30	167	32	30

	(100) Places.	Lat. N.			Lon. E.		
		°	′	″	°	′	″
	Mednoi or Copper I.,						
	— South Point . .	54	32	40	168	10	51
	——					West	
Sea of Kamtschatka.	St. George's Islands .	56	36	0	169	0	0
	Sea Otter's Island .	57	2	15	170	10	30
	St. Paul's Island . .	57	6	0	170	0	0
	Numwack I., N.E. Pt.	60	32	0	165	26	0
	— South East Point .	60	0	0	165	7	0
	Matwi or Gore's I.,						
	— Cape Upright . .	60	17	0	172	30	0
	St. Lawrence Islands,						
	— S. W. end . . .	63	30	0	171	36	0
	— N. W. Point . .	63	46	0	171	41	0
	— East Point . . .	63	18	0	168	48	0
	King's Island . . .	64	52	0	168	0	0
	Bhering's or						
	Gwozdiff's Islands	65	50	0	169	0	0
	Aleaska, S.W. Point .	54	41	0	163	26	0
	Bristol Bay,						
	— Ougaguck R. entr	57	52	0	157	24	0
	— Cape Etolin . .	58	38	0	158	20	0
	— Cape Constantine .	58	28	0	158	45	0
	— Hagemersta Island,						
	Cape Calm . . .	58	33	30	161	11	0
	— Cape Newham. .	58	41	30	162	19	30
	Shoal Ness	60	0	0	162	0	0
Russian America.	Shallow Water Point	63	6	0	162	40	0
	Cape Stephens. . .	63	33	30	162	17	0
	Cape Denbigh. . .	64	23	0	161	40	0
	Cape Rodney . . .	64	39	0	166	20	0
	Cape Prince of Wales	65	35	30	168	0	0
	Cape Lowenstern . .	66	16	0	165	35	0
	Kotzebue's Sound,						
	— Cape Krusenstern	67	4	0	163	37	0
	Var. 25° 40′ *E.*						
	— Chamiso Island .	66	13	11	161	46	0
	Var. 31° 10′ *E.*						
	Point Hope	68	20	0	166	45	0
	Cape Lisburne. . .	68	52	0	166	10	0
	Icy Cape	70	17	30	161	40	0
	Point Barrow . . .	71	25	0	156	10	0
	Var. 42° 15′ *E.*						
	——						
	Point Beechey. . .	70	24	0	149	35	0
	Return Reef . . .	70	25	53	148	52	0
	Var. 41° 20′ *E.*						
	Lion and Reliance Reef	70	12	30	146	51	0
	Flaxman's I., N. side	70	11	22	145	49	57
Russian America.	Barter Island, W. end	70	5	11	143	54	55
	Point Manning . .	70	6	30	143	35	0
	Point Griffin . . .	70	1	0	142	43	0
	Icy Reef	69	43	30	141	29	45
	Demarcation Point .	69	41	0	141	7	0
	Herschel Island, S.Pt	69	33	38	139	3	10
	Babbage R., Pt. Kay	69	18	45	138	10	30
	Var. 46° 16′ *E.*						
	Point Sabine . . .	69	4	0	137	33	0
	Pelly Islands . . .	69	34	0	135	32	0
	Garry I., N.W. end	69	28	52	135	40	55
	Kendall's Island, mid.	69	23	0	135	16	0
	Ellice I., S.W. side .	69	5	0	135	47	0
	Refuge Cove . . .	69	28	59	132	33	0

TABLE LVI.

LATITUDES AND LONGITUDES.

(101) Places.	Lat. N.			Lon. W.		
	°	′	″	°	′	″
Toker Point . . .	69	37	50	132	15	0
Var. 50° 43′ *E.*						
Point Warren . . .	69	47	0	131	35	0
Cape Dalhousie . .	70	16	0	129	18	0
Cape Bathurst . . .	70	36	0	127	35	0
Cape Parry	70	6	0	123	35	0
Var. 55° 47′ *E.*						
Burrow Island . . .	69	49	7	123	33	32
Cape Lyon	69	46	25	122	50	55
Point Deas Thompson	69	45	0	121	20	0
Var. 53° 0′ *E.*						
Point Tinney . . .	69	20	1	119	42	0
Point Clifton . . .	69	13	15	118	27	0
Cape Sir W. Hope .	68	58	23	116	26	0
Point Cockburn . .	68	52	0	115	0	0
Cape Krusenstern .	68	22	0	113	46	0
Bazil Hall's Bay,						
— Cape Hearne . .	68	12	0	114	52	0
Cape Kendall . . .	67	58	26	115	18	0
Point Turnagain . .	68	18	50	109	25	0

XXIV. The EAST COAST of AMERICA from CAPE HORN to CAPE SABLE.

		South			West		
	CAPE HORN	55	58	40	67	12	25
	Var. 22° 30′ *E.*						
	Barnevelt's Islands .	55	49	0	66	40	30
Terra del Fuego.	Evout's Islands . .	55	33	15	66	40	30
	Le Maire's Strait,						
	— Cape Success . .	55	1	30	65	12	30
	— Bay of Success .	54	48	2	65	10	20
	Staten Island,						
	— Cape St. John . .	54	42	10	63	40	30
	— New Year's Harb.	54	4	55	63	59	30
	Cape St. Ines . . .	54	8	0	66	57	45
	Cape St. Sebastian .	53	27	0	67	59	0
	Strait of Magellan,						
	— Queen Catharine's Foreland	52	39	0	68	32	30
	— Cape Virginis . .	52	18	0	68	17	40
	— Cape Froward . .	53	53	20	71	11	0
	River Gallegos,						
Patagonia.	— Graciosa Dios Pt.	51	43	0	69	7	0
	— Cape Fairweather	51	33	0	69	0	0
	Sta. Cruz Harbour .	50	17	30	68	31	30
	Port St. Julian . .	49	8	0	67	43	30
	Port Desire	47	45	0	66	3	30
	Cape Blanco . . .	47	16	0	65	39	30
	St. George's Bay,						
	— Port Cordova . .	45	45	0	67	27	30
	— Port Malaspena .	45	11	15	66	40	0
	Port Melo	45	3	0	66	2	0
	Port St. Antonio . .	45	2	30	65	49	0
	Port St. Elena, obs. .	44	29	45	65	29	45
	Port Valdes . . .	42	30	0	63	40	30
	Rio Negro, entr. . .	40	59	0	63	4	0
	Cape Corrientes . .	38	0	0	57	40	0
	River Plate,						
	— Cape St. Antonio .	36	19	30	56	42	30
	— Point Piedras . .	35	27	0	57	9	0

	(102) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
	River Plate,						
	— BUENOS AYRES . .	34	36	0	58	24	45
	— Colonia	34	28	0	57	53	0
Buenos Ayres.	— Montevideo, Light	34	53	30	56	16	0
	— Maldonado Bay, East Point . . .	34	57	15	54	49	0
	— Gorriti I., N.W. Pt.	34	56	0	54	50	30
	— Flores Island, Light	34	56	30	55	54	0
	— Lobos Island . .	35	1	15	54	44	32
	Cape Sta. Maria . .	34	40	0	54	1	30
	Rio Grande,						
	— Port St. Pedro . .	32	9	0	52	3	0
	St. Catharine's I.,						
	— South Point . .	27	51	30	48	41	0
	— North East Point	27	26	9	48	28	30
	— Point Rapa . . .	27	22	31	48	32	7
	— Desterro Church .	27	35	36	48	39	53
	Anhatomirin Island,						
	— Sta. Cruz Fort . .	27	25	32	48	40	59
	Var. 7° 29′ *E.*						
	Arvoredo Island . .	27	16	47	48	29	0
	Itapacoroya Point .	26	47	18	48	44	6
	Remedios Is., S. end .	26	29	28	48	41	44
	Tamboreti Is., S. end	26	20	54	48	38	45
	St. Francisco River,						
	— Joaò Dias Point .	26	6	33	48	39	41
	Guaratuba River,						
	— Caiuva Mount . .	25	49	30	48	41	23
	Itacolomi Rocks . .	25	50	20	48	32	39
	Coral Rock	25	45	49	48	30	5
East Coast of Brazil.	Paranagua Bay,						
	— South Island . .	25	34	8	48	26	50
	Var. 7° 39′ *E.*						
	Isle do Mel, S. end .	25	32	43	48	25	40
	Figo Rock	25	22	5	48	9	35
	Castillo Rock . . .	25	15	44	48	3	4
	Bom Abrigo Island .	25	6	49	47	57	36
	Jurea Point	24	32	40	47	18	55
	Little Queimada I. .	24	21	26	46	54	32
	Grand Queimada I. .	24	28	21	46	46	35
	Laage Island . . .	24	13	6	46	47	35
	Port of Santos,						
	— Point Taypu . .	24	1	11	46	30	29
	Var. 6° 1′ *E.*						
	— Point Grossa . .	23	59	24	46	24	39
	Moela Island . . .	24	1	56	46	21	52
	Lage de Santos . .	24	18	3	46	17	31
	Mount Trigo . . .	23	51	4	45	51	47
	Alcatrasse Islands . .	24	6	5	45	46	32
	Toquetoque Island .	23	50	19	45	35	34
	St. Sebastian's Island,						
	— Point Seputuba .	23	56	3	45	29	52
	— Point Pirasomungo	23	57	32	45	20	18
	Var. 4° 44′ *E.*						
	— Villa Nueva . .	23	46	52	45	26	42
	Point das Ostres . .	23	34	52	45	17	9
	Porcos Island, S. end	23	33	38	45	10	3
	Busios Is., S. E. end .	23	44	27	45	5	49
	Victoria Island . .	23	47	42	45	13	35
	Point Grossa . . .	23	28	15	45	7	5
	Couves Islands . .	23	25	54	44	57	39
	Joatinga Point . . .	23	18	30	44	38	47

TABLE LVI.

LATITUDES AND LONGITUDES.

(103) Places.	Lat. S.			Lon. W.		
	°	′	″	°	′	″
Grande I., S.W. Pt.	23	15	12	44	29	13
George Greco Island,						
— S.W. Point	23	15	11	44	19	27
Marambaya Hill	23	5	9	44	8	19
La Gabia or Gavia	22	59	0	43	22	43
RIO JANEIRO or						
St. Sebastian	22	54	15	43	15	50
Var. 3° 40′ *E.*						
Ratos or Rat Island	22	53	16	43	14	59
Sugar Loaf	22	56	8	43	14	28
Gloria	22	54	42	43	15	34
Redondo or Round I.	23	3	45	43	17	4
Marica Islands	23	0	53	42	59	53
Cape Negro	22	57	10	42	44	54
Cape Frio	23	1	18	42	3	19
Var. 2° 30′ *E.*						
Papagoyos Islands,						
— N. E. end	22	52	9	41	58	20
Anchora Is., E. end	22	46	26	41	50	57
Cape Buzois	22	46	3	41	55	53
St. John's Hill	22	32	26	42	6	19
St. Ann's Is., largest	22	25	0	41	46	22
Cape St. Thomas, abt.	22	3	0	41	0	0
Point Maruba	21	11	0	40	50	0
Mount Benevente	20	55	21	40	49	24
Guarapari	20	43	56	40	32	42
East Coast of Brazil.						
Calvado Island	20	44	8	40	27	8
Rasas Island	20	42	42	40	24	31
Jicu Point	20	26	1	40	22	1
Jicu Island	20	23	9	40	20	30
Pacotes Rocks	20	21	2	40	17	29
Var. 0° 56′ *E.*						
Espiritu Santos Bay,						
— Mount Moreno	20	19	23	40	19	25
— Victoria, Town	20	19	0	40	23	0
— Point Tubarao	20	16	22	40	17	29
Rio Doce, entr.	19	36	57	39	51	21
Var. 0° 5′ *E.*						
St. Matthew's R. entr.	18	37	10	39	45	5
Abrolhos Is., largest	17	57	44	38	41	54
Var. 0° 46′ *W.*						
Parades Shoals, N. end	17	56	45	38	54	20
Prado, Town	17	21	28	39	12	19
Columbiana	17	6	1	39	11	58
Cramimuan R., entr.	16	51	12	39	9	29
Mount Pascal	16	54	8	39	25	25
Porto Seguro	16	26	50	39	3	18
Var. 0° 54′ *W.*						
Santa Cruz	16	18	50	39	1	49
Belmonte	15	51	4	38	54	13
Commandatuba	15	25	20	38	56	22
Unha	14	59	7	38	57	45
St. George dos Ilheos	14	49	25	39	0	10
Os Ilheos	14	47	23	38	58	58
Contas	14	18	6	39	0	2
Mula Point	13	53	5	38	56	37
Queipé Island	13	50	58	38	56	35
Boypeda Island	13	37	43	38	56	35
St. Paul's Mount	13	21	53	38	54	8
Itaporica Island,						
— South Point	13	7	33	38	46	21
— N. S. de Penha	12	59	16	38	36	24

(104) Places.	Lat. S.			Lon. W.		
	°	′	″	°	′	″
— Jaburu	12	57	36	38	35	41
— Mount Amaro	13	1	8	38	45	15
Bay of Santos,						
— Frades Island	12	49	28	38	37	45
St. Salvador or Bahia,						
— Mount Serati	12	55	58	38	30	49
— St. Antonio	13	0	11	38	31	34
Var. 1° 58′ *W.*						
Itapuanzinho Point	13	0	59	38	27	55
Itapuan	12	57	3	38	21	28
Jacuipe River, entr.	12	41	52	38	7	28
Garcia de Avila	12	32	26	38	0	43
Rio Real, S. Point	11	28	4	37	20	13
Os tres Irmaos or						
Three Brothers	11	15	37	37	9	58
Vasa Barris River	11	11	0	37	16	51
St Francisco R., S. Pt.	10	28	50	36	23	22
Var. 3° 10′ *W.*						
St. Antonio Mount	9	22	17	35	35	5
Porto Francez	9	39	45	35	41	19
East Coast of Brazil.						
Quinta	9	16	18	35	22	25
St. Bento	9	4	56	35	16	57
Tamandaré Fort	8	43	24	35	5	0
Fermoso River	8	39	40	35	4	22
Aleixo Islands	8	35	49	35	0	46
Maracay	8	29	26	34	59	37
Cape St. Augustine	8	20	41	34	56	42
Var. 4° 30′ *W.*						
Rosario	8	9	18	34	55	52
Pernambuco,						
— Recife, Tower	8	4	7	34	52	44
— Fort Picao	8	3	27	34	51	50
Var. 4° 45′ *W.*						
Olinda	8	0	59	34	50	48
Sta. Maria Farinha	7	56	43	34	50	36
Rio Aye, entrance	7	47	13	34	50	35
River Goyana, entr.	7	30	44	34	47	8
Pilar, Village	7	35	35	34	47	47
R. Grande de Goyana	7	30	40	34	46	22
Cape Branco	7	8	22	34	48	5
North Paranahyba	7	6	3	34	53	0
Paranahyba River,						
— Fort Cabedello	6	57	50	34	50	11
Point Lucena	6	53	35	34	50	35
Traico Bay, N. Point	6	41	15	34	57	23
Formosa Bay, S. Pt.	6	23	12	35	0	12
River Cunhao	6	17	10	35	3	25
Point Pipa	6	12	53	35	3	42
Point Negra	5	52	52	35	7	35
Rio Grande, Fort	5	45	0	35	14	31
CAPE ST. ROQUE	5	28	17	35	17	10
North Coast of Brazil.						
Var. 4° 55′ *W.*						
Point Petetinga	5	21	35	35	19	30
Point Calcanhar	5	8	20	35	30	40
Lavandeira Breakers	4	54	40	36	2	10
Urcas Breakers	4	51	32	36	18	35
Point Tubarao	5	1	49	36	28	10
Point do Mel	4	55	17	36	59	15
Reteiro Pequino	4	48	16	37	19	15
Reteiro Grande	4	36	20	37	32	55
Aracati Mount	4	42	10	37	54	50

TABLE LVI.

LATITUDES AND LONGITUDES.

	(105) Places.	Lat. S.			Lon. W.		
		°	′	″	°	′	″
	Point Macoripi . .	3	41	50	38	30	51
	Var. 3° 0′ *W.*						
	Seara or Ciara . .	3	42	58	38	33	58
	Mount Melancia . .	3	11	40	39	19	31
	Perpambuquinho . .	3	1	50	39	37	28
	Patos River, entrance	2	58	50	39	40	3
	Jericacoara Point . .	2	47	28	40	27	25
	Camercim River, entr.	2	50	0	40	45	5
	Tapuya Mount . . .	2	58	25	40	50	39
	Iguarassu River, entr.	2	52	27	41	18	12
North Coast of Brazil.	Tutoya River, entr. .	2	41	13	41	42	11
	Perguicas R., E. Pt. .	2	41	27	42	27	11
	LancoesGrandes, E.Pt	2	26	12	43	0	1
	Alegre Mount . . .	2	20	17	43	13	14
	Var. 0° 0′						
	St. Ann's Breakers,						
	— East Point . . .	2	12	38	43	29	39
	St. Ann's I., N.E. Pt.	2	14	44	43	38	26
	CoreaGrandeBreakers						
	— North Part . . .	2	10	55	43	57	41
	Maranham Island,						
	— White Down on North side . . .	2	24	36	44	4	18
	— Fort St Marcos .	2	28	22	44	16	3
	— Fort St. Antonio .	2	29	24	44	16	56
	Var. 1° 37′ *W.*						
	— St. Luiz	2	30	44	44	16	9
	Alcantara	2	23	33	44	23	7
	Mount Alegré . . .	2	17	16	44	20	5
	Mount Itacolimi . .	2	8	38	44	24	33
	Shoal of Manoel Luiz						
	— West Rock . . .	0	51	25	44	14	45
	Var. 0° 57′ *E.*						
	Appleton's Shoal . .	0	45	0	44	10	0
	Sylva Shoal	0	32	0	44	17	21
	Para or Belim . .	1	28	0	48	30	0
	Cape Magoary . . .	0	14	0	48	20	0
		North					
	Cape North	1	51	0	50	9	0
	Oyapok River,						
	— St. Louis, Fort .	3	57	0	51	41	0
	Cayenne, Flagstaff .	4	56	19	52	14	45
	Var. 2° 28′ *E.*						
	Surinam R., Brams Pt.	5	56	0	55	15	0
Guayana.	Berbice R. entr. . .	6	20	0	57	11	0
	River Demerary,						
	— Corrobano Pt., Lt.	6	48	0	58	1	35
	— George Town . .	6	47	0	58	1	0
	Cape Nassau . . .	7	32	0	58	49	0
	Guayma River, entr.	8	25	0	59	52	0
	Orinoco River,						
	— Point Barima . .	8	44	30	60	3	0
	— Old Guayana . .	8	8	24	62	23	0
	— Angostura . . .	8	8	11	63	55	20
	The Testigos, N.E.Pt.	11	24	30	63	9	30
	La Sola	11	19	30	63	39	45
	Los Frayles, N. Rks.	11	15	30	63	50	0
	Margarita,						
	— Mosquitos or S. E. Point . . .	10	53	0	63	59	0

	(106) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
The Leeward Islands.	Margarita,						
	— Pampatar . . .	10	59	15	63	53	30
	— Balena Point . .	10	59	0	63	51	45
	— North Point . .	11	10	30	63	58	30
	— Galera Point . .	11	6	30	64	4	30
	— Tuna Point . . .	11	5	30	64	18	0
	— Sandy Point . .	10	59	0	64	29	30
	— Mangles Point . .	10	52	0	64	9	0
	Blanquilla,						
	— North Point . .	11	54	30	64	41	50
	— S. E. Point . . .	11	48	30	64	40	15
	Tortuga,						
	— S. E. Point . . .	10	55	0	65	16	50
	— West Point . . .	10	56	30	65	29	30
	Orchilla, East end	11	49	0	66	9	30
	— West end . . .	11	49	0	66	15	40
	Two Fathoms Shoal .	12	9	15	66	9	20
	Los Roques, S.E. Pt.	11	47	0	66	39	0
	— Salt Kay, W. Pt. .	11	46	0	66	54	0
	— N. E. Kay . . .	11	58	40	66	42	20
	— West Kay . . .	11	50	0	67	1	0
	Aves or Bird's Islands,						
	— East end . . .	11	57	30	67	30	30
	— West End . . .	11	59	30	67	45	30
	Buenayre, N. Point .	12	19	15	68	30	0
	— Rasa or S. Point .	12	2	30	68	21	30
	Curacao, N. Point .	12	24	0	69	16	20
	— Fort Amsterdam .	12	16	15	69	3	0
	Little Curacao, N. end	12	0	0	68	44	30
	Oruba, S. E. Point .	12	23	45	69	59	30
Coast of Colombia.	Cape Three Points .	10	45	15	62	46	0
	Cape Malapasqua . .	10	42	50	63	6	35
	Cumana	10	27	37	64	15	15
	Porto Mochima, entr.	10	24	0	64	26	30
	Borracha I., N.E. Pt.	10	19	30	64	49	20
	Barcelona, Castle .	10	13	15	64	48	20
	Piritu Isles, mid. . .	10	9	0	65	1	35
	Unare Island, middle.	10	5	30	65	21	15
	Cape Codera . . .	10	35	54	66	11	30
	Point Chuspa . . .	10	39	30	66	25	30
	La Guayra, Road . .	10	37	0	67	1	35
	Caracas	10	30	0	67	0	55
	Port Turiamo . . .	10	29	10	67	57	20
	Porto Cabello, entr. .	10	29	45	68	7	35
	Tucocas Point . . .	10	50	0	68	20	5
	St. Juan's Point . .	11	9	0	68	31	35
	Ubero Point . . .	11	19	30	68	49	15
	Manzanille Point . .	11	31	15	69	24	5
	Vela de Coro . . .	11	26	30	69	42	5
	Cape St. Roman . .	12	11	0	70	8	35
	Sta. Anna de Coro .	11	24	0	69	49	50
	Zapara Fort . . .	10	58	30	72	31	30
	Maracaybo	10	39	0	71	45	0
	Point Espada . . .	12	4	0	71	11	50
	Bahia Honda, entr. .	12	20	0	71	50	35
	Cape La Vela . . .	12	11	0	72	15	35
	La Hacha	11	33	30	72	58	55
	Cape St. Augustin .	11	16	0	73	40	5
	C. St. Juan de Guia .	11	20	45	74	4	20
	Cape de la Aguja . .	18	18	30	74	16	20
	Santa Marta . . .	11	15	0	74	17	35

TABLE LVI.

LATITUDES AND LONGITUDES.

	(107) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Magdalena River,						
	— Rio Viego, entr.	11	5	0	74	47	35
	— Ceneza entr.	11	5	20	74	56	20
	Savanilla Point	11	2	0	75	3	0
	Morro Hermoso	10	58	0	75	4	45
	Cascabel Rock	10	55	10	75	7	45
	Galera Point	10	47	0	75	29	5
	Canoas Point	10	34	15	75	35	50
	CARTAGENA, Popo	10	26	0	75	37	5
	Salmedina Shoal	10	23	0	75	44	35
	Rosario Isles, largest	10	11	0	75	49	35
	St. Bernardo Islands,						
Coast of Colombia.	— Tintipan Island	9	48	0	75	55	30
	Santiago di Tolu	9	30	45	75	39	50
	Port Aspata, entrance	9	25	0	75	51	55
	Fueste Island	9	23	30	76	15	5
	Gulf of Darien,						
	— Point Arenas	8	33	0	77	0	5
	— Cape Tiburon	8	41	15	77	26	35
	Carreto	8	47	15	77	38	35
	Pinos Island, N. Pt.	9	1	30	77	50	30
	Cayo Ratones	9	23	0	78	20	5
	Point St. Blas	9	31	36	79	2	5
	Point Manzanillo	9	39	30	79	36	50
	PUERTO VELO or						
	PORTO BELLO	9	34	29	79	43	40
	Point Toro	9	23	45	80	1	20
	Chagres	9	21	0	80	4	5
	Port Cartago	10	4	0	82	35	0
	Port St Juan						
	de Nicaragua,						
	— Point Arenas	11	0	0	82	44	0
	Bluefields or						
	New Segovia	11	49	0	83	2	0
	Roncador	13	35	7	80	3	3
	Serranna, N. side	14	28	36	80	15	0
	— South side	14	18	17	80	15	0
	Serranilla, E. side	15	45	20	79	51	15
	CAPE GRACIOS A DIOS	14	55	0	82	45	0
Bay of Honduras.	Cape Camaron	16	2	0	85	14	0
	Cape Honduras	16	0	0	86	5	0
	Truxillo	15	54	0	86	2	0
	Swan Islands, S.E. Pt.	17	22	30	83	51	0
	Albion Sh., E.N.E. end	18	55	0	83	9	0
	Guanaja or Bonacca,						
	— North East Point	16	31	20	85	55	30
	Barburat Island	16	27	0	86	10	0
	Ruatan or Rattan,						
	— West Point, about	16	16	0	86	51	0
	Cape Three Points	15	58	0	88	34	0
	Teemarsh River	15	59	0	88	56	0
	Moho River	16	3	30	88	49	0
	Point Icacos	16	15	0	88	36	0
	Point Placentia	16	28	0	88	21	0
	Sittee River	16	48	0	88	19	0
	Manati River	17	14	0	88	19	0
	Seboon River	17	25	0	88	15	0
	BELIZE, Fort George	17	29	29	88	11	15
	Glover's Reef, N. end	16	54	0	87	40	0
	— South End, about	16	41	0	87	49	0
	Half Moon Kay, Light	17	12	45	87	33	0

	(108) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Hat Kay Reef, S. end	17	6	0	87	40	0
	Turneff Kays,						
	— Kay Bokel	17	9	40	87	56	0
	— Maugre Kay	17	37	30	87	41	0
	English Kay	17	19	30	88	2	30
	St. George's Kay, S. Pt.	17	33	0	88	2	0
	Ambergris Kay, S. Pt.	17	49	0	88	1	0
	Northern Triangles,						
	— South end	18	20	0	87	20	0
	— North end	18	45	0	87	15	0
	Cozumel, S. Point	20	16	45	86	55	0
	— North Point	20	39	0	86	44	0
	Arrowsmith's Bk mid.	21	3	0	86	21	0
	Punta Brava	21	0	0	86	44	0
	Cape Catoche	21	34	0	86	57	30
	Mount Notiperderas	21	10	9	90	2	30
	Campeche, Town	19	51	0	90	30	0
	Alacran Shoal,						
	— Perez Island	22	22	0	89	41	0
	Negrillo Bank	23	25	0	90	12	37
	Arenas or Sandy I.	22	8	0	91	20	0
	New Shoal	21	50	0	91	55	0
	Triangle	20	53	0	92	10	0
	Obiso or Bishop's Sh.	20	30	0	92	12	0
	The Arcas	20	12	0	91	56	0
	Javinal Point	19	12	30	90	56	30
	Jicalango Point	18	41	30	91	54	0
	Barra de St. Pedro	18	40	0	92	29	30
	Barra de Tabasco	18	34	16	92	39	13
	B. de Chiltepeque	18	26	30	93	3	0
	Tupilco River, entr.	18	25	0	93	25	0
	B. de Coazacoalcos	18	8	0	94	22	0
	La Barilla	18	9	0	94	35	0
	Point St. Juan	18	18	0	94	38	0
	Roca Partida	18	43	0	95	6	0
	Barra de Alvarado	18	46	0	95	43	0
	Anton Lizardo Point	19	3	0	95	55	0
	VERA CRUZ, Light	19	12	15	96	7	12
	Orizava Peak	19	2	17	97	12	15
	Cofre di Perote	19	32	54	97	8	0
Mexico.	MEXICO	19	25	45	99	5	30
	Cape Roxo	21	35	0	97	23	0
	Barra de Tampico	22	15	56	97	52	0
	Barra de Tordo	22	52	0	97	54	0
	Barra de Santander	23	46	0	97	58	0
	Boquillas Cerradas	25	0	0	97	40	0
	River de S. Fernando	25	20	0	97	29	0
	Barra de Santiago	26	6	0	97	10	0
	Barra de S. Bernardo	28	55	0	95	48	0
	Point Culebras	29	15	0	94	48	0
	Barra del R. Sabina	29	36	0	94	2	0
	R. Mermentan, entr.	29	30	0	92	55	0
	Fierro Point	29	12	0	91	28	0
	Mississippi River,						
	— S W. entrance	28	58	0	89	29	0
United States.	— South entrance	28	58	0	89	11	0
	— Frank's I., Light	29	8	30	89	6	0
	— Balize	29	7	30	89	10	0
	— Pass à l'Outre	29	13	0	89	8	0
	NEW ORLEANS	29	57	30	90	6	17
	Mobile, Bar	30	10	0	88	10	0
	Var. 6° 58′ E.						

LATITUDES AND LONGITUDES.

(109) Places.	Lat. N.			Lon. W.		
	°	′	″	°	′	″
Mobile, Town . . .	30	39	0	88	12	0
Pensacola, Bar . . .	30	18	0	87	16	0
Pensacola, Town . .	30	23	43	87	11	18
Sta. Rosa Bay, entr. .	30	23	0	86	36	0
St. Andrew's Island .	30	1	0	85	51	0
Cape St. Blas . . .	29	38	0	85	40	0
Apalaché or St. Mark.	30	12	0	84	30	0
Anclote Kay, mid. . .	28	20	0	83	12	0
Spiritu Santo Bay, ent.	27	42	0	82	52	0
Boca de Sarazota . .	27	17	0	82	39	0
Carlos Bay, entr. . .	26	37	0	82	12	0
Punta Larga, or Cape Roman . . .	25	50	0	81	46	0
Cape Sable	25	1	0	81	10	0

XXV. THE WEST INDIA ISLANDS.

	Bermudas, or Somer's Islands,						
	— St. George Town .	32	22	20	64	37	40
	— St. David's Head .	32	21	20	64	35	40
	— S. extreme of land .	32	13	10	64	46	40
	— Wreck Hill or W. end	32	15	20	64	50	0
	Var. 2° 50′ *W.*						
	— North Rock . . .	32	29	0	64	42	50
	— Mills' Breaker . .	32	27	0	64	33	0
Little Bahama Bank.	Maternillo Bank,						
	— North end. . . .	27	51	0	79	10	0
	Maternillo Reef,						
	— N. W. end . . .	27	34	0	79	9	0
	Outer part of Western Reef. . .	27	5	0	79	12	0
	Memory Rock . . .	26	55	0	79	2	0
	Sandy Cay	26	48	0	79	1	0
	Great Bahama Island,						
	— West Head . . .	26	41	0	79	1	0
	— S. E. Point . . .	26	28	0	78	40	0
	Great Abaco Island,						
	— Lighthouse . . .	25	51	30	77	10	45
	Var. 3° 30′ *E.*						
	— N. E. Point . . .	26	19	0	76	55	0
	— Whale Cay Rocks .	26	44	0	77	4	0
Great Bahama Bank.	Eleuthera, S. E. Point	24	38	0	76	9	0
	— Town	25	0	0	76	12	0
	— James' Cistern . .	25	20	0	76	23	0
	— Harbour I., E. end.	25	30	0	76	39	0
	— Egg Island, Reef .	25	33	45	76	55	30
	Douglas' Passage, ent.	25	8	30	77	5	45
	New Providence,						
	— Nassau, Light . .	25	5	0	77	22	15
	Var. 5° 30′ *E.*						
	Berry Islands,						
	— South Stirrup . .	25	25	0	77	54	0
	— Great Stirrup Cay, N. E. end . . .	25	50	0	77	53	0
	Little Isaac	25	58	0	78	48	0
	Great Isaac, mid. . .	26	2	30	79	3	0
	Moselle Shoal . . .	25	50	0	79	15	0
	Bemini Islands,						
	— Barnett's Harbour.	25	39	0	79	20	0
	Gun Cay, Light. . .	25	34	30	79	18	24

	(110) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Riding Cays	25	11	0	79	8	0
	Orange Kays, mid. .	24	55	30	79	7	0
	Roquillas	24	52	0	79	6	0
	Salt Kay Bank,						
	— Anguilla Kay, Well	28	31	0	79	29	0
	— Salt Kay	23	42	0	80	20	0
	— Elbow Kay . .	23	55	0	80	25	30
	— Dog Rocks, mid. .	24	3	0	79	49	0
Great Bahama Bank.	Guincho or Ginger Kay	22	47	0	77	57	0
	Lobos or Seal's Kay .	22	24	0	77	29	0
	Diamond Point . . .	22	9	0	77	12	0
	St. Domingo Kay . .	21	43	0	75	45	0
	Kayo Verde, E. end .	22	1	0	75	10	30
	Jumentos,						
	— Brothers' Rocks .	22	1	0	75	40	0
	— KaySal or Ragged I.	22	11	30	75	41	0
	— Man of War Kay, South end	22	47	20	75	53	40
	Water Cay	23	0	0	75	44	0
	Yuma or Long Island,						
	— South Point . . .	22	51	0	74	52	0
	Var. 5° 0′ *E.*						
	— Great Harb., ent. .	23	6	0	75	2	30
	— Cliffs	23	28	0	75	11	0
	— North end . . .	23	40	37	75	18	0
	Great Exuma Island,						
	— Harbour	23	34	0	75	49	0
The Passage Islands.	St. Salvador or Cat I.,						
	— Colombas or S.E.Pt.	24	8	0	75	17	30
	— Hawk's Nest, or S. W. Point . . .	24	10	0	75	33	0
	Little Cat I., N.W. Pt.	24	36	0	75	59	0
	Conception I., S. end .	23	48	46	75	6	0
	Southampton Reef,						
	— North end . . .	23	56	0	75	7	0
	Rum Kay, E. end . .	23	38	40	74	47	20
	— West end	23	39	0	74	56	35
	Watling's I., S. W. Pt.	23	56	0	74	34	0
	— Rock at N. end . .	24	10	30	74	28	30
	Var. 5° 0′ *E.*						
	Attwood's Kay, or Samana, E. end . .	23	5	10	73	48	0
	— Western Reef. . .	23	5	50	73	50	50
	— Eastern Reef . .	23	4	45	73	36	0
	Plana or Flat Kay, mid.	22	35	10	73	37	0
	Crooked Islands,						
	— Rock just above Water	22	44	45	73	51	0
	— N. E. Reef, end .	22	43	0	73	47	0
	— Bird Rock . . .	22	51	0	74	22	15
	— Post Office . . .	22	47	0	74	20	0
	— Fortune I., S. Point	22	33	0	74	23	0
	— Castle Island . .	22	7	30	74	18	45
	Miraporvos,						
	— North Rock . . .	22	7	50	74	31	40
	— South Kay . . .	22	5	0	74	31	15
	— Shoal, S. E. end .	21	58	30	74	28	30
	Diana's Shoal, mid. .	22	31	30	74	46	0
	Mariguana Island,						
	— S. W. Point . . .	22	21	0	73	14	0
	— East Reef. . . .	22	17	0	72	38	0
	The Hogsties, W. end	21	41	0	73	51	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(111) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Great Inagua,						
	— N. W. Point . . .	21	8	0	73	40	0
	— S. W. Point . . .	20	55	0	73	38	30
	— S. E. Point . . .	20	58	0	73	9	0
	— N. E. Point . . .	21	21	0	73	1	0
	Statira Shoal . . .	20	55	0	73	9	0
	Little Inagua,						
	— East Point . . .	21	28	30	72	55	30
The Passage Islands.	— S. W. Point . . .	21	26	0	73	3	0
	Caycos Bank,						
	— N. end of Bank . .	21	59	0	71	57	0
	— W. Caycos, S.W. Pt.	21	37	0	72	28	0
	— S. E. end of Bank .	21	2	0	71	28	0
	— N. E. end of Bank .	21	41	0	71	18	0
	Turk's Islands,						
	— Endymion's Shoal .	21	6	0	71	15	0
	— Sand Kay, mid. . .	21	11	0	71	13	0
	— Salt Kay, mid. . .	21	18	0	71	8	0
	— Grand Kay, N. end	21	30	0	71	4	0
	Mouchoir Carré, or Square Handkerchief,						
	— S. W. end	20	53	0	70	55	40
	— N. E. end	21	6	0	70	26	0
	Silver Bank,						
	— N. W. end . . .	20	53	0	69	53	0
	— N. E. end	20	33	0	69	18	0
	— S. E. end	20	13	50	69	35	0
	Fletcher's Rock . .	20	15	0	70	0	0
	Bajo de Navidad,						
	— N. end	20	12	0	68	48	0
	— S. end	19	53	0	68	54	0
	Cape de Cruz . . .	19	47	16	77	40	30
	Tarquino Peak . . .	19	52	57	76	45	30
	St. Jago de Cuba, entr.	19	57	29	76	2	45
	Guantanamo or Cumberland Hr., entr.	19	54	5	75	14	30
	Escondido, E. Point .	19	54	55	75	2	36
	Baitiqueri, entrance .	20	2	0	74	50	0
The Island of Cuba.	Cape Maize or Maysi .	20	13	30	74	1	0
	Mata, entrance . . .	20	17	10	74	12	30
	Baracoa, entrance . .	20	20	50	74	21	0
	Navas, entrance . .	20	29	44	74	27	52
	Taco, W. Point . . .	20	31	17	74	33	30
	Jaragua, entrance . .	20	32	44	74	36	30
	Guarico Point . . .	20	39	0	74	41	0
	Cayo Moa	20	42	18	74	49	0
	Tanamo, entrance . .	20	42	41	75	14	0
	Cabonico, entrance .	20	42	11	75	23	40
	Nipe, entrance . . .	20	44	40	75	29	0
	Port Banes, S. E. Pt. .	20	52	50	75	36	0
	Point Mulas	21	7	30	75	35	0
	Naranjo, entrance . .	21	5	23	75	53	10
	Gibara, entrance . .	21	6	12	76	7	0
	Padre, entrance . . .	21	15	40	76	26	30
	Manato, entrance . .	21	23	44	76	44	0
	Nuevas Grandes, entr.	21	26	50	76	51	0
	Maternillos Point . .	21	39	0	76	59	30
	Cayo Romano, S.E. Pt.	21	53	0	77	36	0
	Cayo Verde	22	5	6	77	36	15
	Cayo Confites, N. Pt. .	22	11	44	77	37	0
	Cruz del Padre . . .	23	14	0	80	56	30
	Matanzas, Castle . .	23	2	54	81	32	0
	— Pan or Hill . . .	23	1	39	81	34	30
	Havanna, Light . .	23	8	18	82	22	4

	(112) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Port Mariel, entrance .	23	5	58	82	42	30
	Cavanas, entrance . .	23	4	0	82	52	30
	Bahia Honda, entrance	22	58	49	83	6	40
The Island of Cuba.	Cape Antonio . . .	21	54	0	84	57	30
	Cape Corrientes . .	21	48	0	84	29	20
	Point Piedras . . .	21	56	30	83	50	0
	Cayo de St. Felipe,						
	— West end	21	59	0	83	33	0
	Indian Kays, N. end .	21	54	30	83	15	0
	Isle of Pines,						
	— Point Indus . . .	21	49	0	83	4	0
	— Point St. Francis .	21	42	0	83	9	0
	Var. 9° *E.*						
	— Point Crocodillo. .	21	31	37	83	0	0
	— East Point . . .	21	36	0	82	24	0
	Xagua Bay, entrance .	22	0	0	80	35	37
	Port Casilda, entrance	21	35	25	80	2	0
	Cayo Blanco	21	33	45	79	58	30
	Zarga de Fuera . . .	21	23	30	79	41	55
	Cayo Breton, S. Point	21	3	10	79	32	42
	Roca Grande, entr. .	20	57	30	79	23	0
	Morant Point	17	58	0	76	6	0
	North East Point . .	18	12	0	76	16	30
	Port Antonio, entr. .	18	16	0	76	23	0
	Galina Point	18	29	30	76	54	0
	St. Anne's Bay, ent. .	18	31	0	77	16	0
	Martha Brae, entr. .	18	32	0	77	44	0
	Montego Bay, Point .	18	32	30	78	2	30
	North Negril . . .	18	24	0	78	30	0
	South Negril. . . .	18	15	45	78	32	0
	John's Point	18	11	30	78	22	0
Jamaica.	Savanna la Mar . . .	18	13	0	78	15	0
	Black River, entr. . .	18	1	10	77	56	0
	Pedro Bluff	17	50	30	77	49	0
	Portland Point . . .	17	42	30	77	7	30
	Kingston Church . .	17	57	57	76	46	10
	Port Royal, Point .	17	55	7	76	49	0
	Var. 5° 50′ *E.*						
	Yallah Point	17	52	0	76	28	0
	Caymanbrack, W. Pt. .	19	46	0	79	46	0
	Little Cayman, S.W. Pt.	19	36	0	80	5	0
	Grand Cayman,						
	— S. W. Kay or Point	19	15	0	81	29	0
	— East end	19	18	30	81	5	0
	Var. 8° 0′ *E.*						
	Swan Islands, S. E. Pt.	17	22	30	83	51	0
	Baxa Nueva,						
	— Sandy Kay . . .	15	52	20	78	37	58
	Serranilla, E. end . .	15	45	20	79	50	15
	Pedro Bank,						
	— Portland Rock . .	17	7	30	77	26	0
	— North East Kay .	17	4	30	77	46	0
	— South Kay . . .	16	57	0	77	51	0
	— Rock	16	48	0	78	12	0
	Morant Kays,						
	— North East Kay .	17	26	30	75	54	0
	— South West Kay .	17	23	45	75	56	0
	Formigas Bank,						
	— North East edge .	18	34	30	75	38	0
	— South East edge .	18	28	30	75	40	0
	— South West edge .	18	28	0	75	48	0
	Navaza, middle . . .	18	23	15	75	6	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(113) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	——						
	St. Nicholas Mole Pt.	19	49	20	73	27	30
	Port à Piment . . .	19	35	0	72	57	3
	St. Mark's Point . .	19	2	18	72	50	0
	Arcadins, South end .	18	45	0	72	38	30
	PORT AU PRINCE,						
	— The Road . . .	18	33	42	72	23	45
	Gonave I., N. E. Pt. .	18	48	35	72	49	47
	— West Point. . .	18	57	0	73	19	0
	Petite Goave,						
	Hummock . . .	18	26	51	72	50	30
	Rochelois Reef,						
	— Pirogues . . .	18	37	20	73	12	0
	Point Jeremie . . .	18	39	57	74	6	0
	Cape Donna Maria .	18	37	25	74	25	0
	Point des Irois . . .	18	22	23	74	30	30
	CAPE TIBURON . . .	18	19	25	74	27	32
Hayti or St. Domingo.	Point à Gravois . .	18	1	3	73	55	0
	Isle à Vache, E. Pt. .	18	4	0	73	31	30
	Les Cayes, Town . .	18	11	10	73	44	0
	St. Louis, Old Fort .	18	14	27	73	31	30
	Aquin Bay,						
	— Diamond Rock .	18	13	48	73	20	0
	Cape Jaquemel . .	18	11	20	72	33	30
	Alto Vela Rock . .	17	28	11	71	40	30
	Point Salinas . . .	18	12	40	70	49	30
	ST. DOMINGO, City .	18	28	40	69	59	37
	Sta. Catalina I., W.Pt.	18	19	0	69	1	0
	Sama I., S. E. Point .	18	12	0	68	31	30
	Point Espada . . .	18	19	48	68	30	0
	Cape Enganno . . .	18	34	30	68	20	30
	Cape Samana . . .	19	15	40	69	6	15
	Cape Cabron . . .	19	22	0	69	12	50
	Old Cape François .	19	40	30	69	56	30
	Point Isabella . . .	19	58	43	71	12	0
	The Grange . . .	19	54	35	71	43	10
	CAPE HAYTIEN, City .	19	46	20	72	14	0
	Tortuga Island, W. Pt.	20	5	20	72	54	56
	— East Point . . .	20	3	33	72	34	10
	Port Paix	19	56	0	72	43	0
	Port à L'Ecu . . .	19	55	8	73	5	0
	——						
	Mona Island, middle .	18	6	0	67	49	0
	Monica	18	9	0	67	57	0
	Zacheo	18	23	48	67	27	30
	——						
	C. St.Juan, or N.E.Pt.	18	24	20	65	39	0
	ST. JUAN, Castle . .	18	29	10	66	6	52
Porto Rico	Pt. Bruquin or N.W.Pt	18	31	18	67	7	0
	Aguadilla Town . .	18	25	10	67	7	17
	Algarroba Point . .	18	14	0	67	7	30
	Cape Roxo	17	58	30	67	11	0
	Puerto Guanica . .	17	57	44	66	52	45
	Caxa de Muertos . .	17	50	30	66	35	0
	——						
Virgin Islands.	St Thomas' Harbour,						
	— Fort Christian . .	18	20	5	64	57	0
	Var. 2° 30′ E.						
	St. John's S. E. Point	18	19	0	64	44	20
	Virgin Gorda, E. Pt.	18	31	7	64	21	30
	Anegada, S. E. Point	18	43	48	64	16	30

	(114) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	St. Croix or Sta. Cruz,						
	— Christianstad . .	17	44	8	64	43	30
	——						
	Sombrero	18	38	0	63	29	30
	Anguilla, S. W. Point	18	11	0	63	16	0
	— North East Point .	18	16	0	63	2	30
	St. Martin, N.W. Pt.	18	4	0	63	14	0
	St. Bartholomew, E.Pt.	17	53	35	62	52	30
	Saba, middle . . .	17	39	20	63	19	0
	St. Eustatius, Road .	17	29	30	63	4	30
	St. Christopher,						
	— Basse Terre . .	17	19	30	62	49	15
	Nevis, Town . . .	17	10	30	62	43	0
	Barbuda, N. Point .	17	43	0	61	52	0
	Antigua,						
	— St. John's Road .	17	9	40	61	57	0
	— English Harbour .	17	3	0	61	50	0
	Redonda.	16	55	30	62	26	0
	Monserrat, N.E. Pt. .	16	48	0	62	16	40
	Guadaloupe,						
	— Basse Terre . .	15	59	30	61	47	30
	— Old Fort.	15	56	0	61	45	30
	— Chateau Point . .	16	12	30	61	12	0
	— North Point . .	16	30	0	61	37	0
	Aves or Bird's I. .	15	40	56	63	35	0
	Deseada, N. E. Point	16	20	0	61	6	30
	Mariegalante,						
Carribbee Islands.	— Basse Terre . .	15	52	15	61	22	0
	Saintes, S.W. end .	15	51	20	61	44	0
	Dominica,						
	— Pr. Rupert's Bay .	15	35	30	61	33	0
	— Roseau	15	18	23	61	28	0
	— Scot's Head . .	15	12	0	61	26	0
	Martinique,						
	— Fort Royal . . .	14	35	55	61	7	30
	— Port St. Pierre .	14	44	30	61	14	0
	— Macouba Point .	14	52	40	61	11	30
	— Saline Point . .	14	23	50	60	56	10
	Var. 2° 47′ E.						
	— Diamond Rock .	14	26	30	61	6	0
	St. Lucea,						
	— Careenage, entr. .	13	57	0	61	7	0
	— Point Piton . .	13	42	0	61	13	0
	— Moulacique Point	13	35	0	61	2	0
	St. Vincent,						
	— Kingston . . .	13	9	0	61	15	0
	Barbadoes,						
	— North Point . .	13	19	0	59	44	0
	— Bridgetown . . .	13	5	30	59	43	15
	— South Point . .	13	3	0	59	39	0
	Granadillos,						
	— Becouya, N. Point	13	3	0	61	13	0
	— Cariaco, N. Point	13	32	0	61	30	0
	Grenada,						
	— North East Point .	12	14	0	61	42	0
	— Fort St. George .	12	2	54	61	49	40
	— Point Salines . .	11	58	0	61	52	0
	Tobago, N. E. Point	11	23	0	60	27	0
	— Man of War Bay	11	22	0	60	32	0
	— South West Point	11	9	0	60	52	0
	Trinidad,						
	— Boca de Navois .	10	41	45	61	48	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(115) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Trinidad,						
	— Chaguaramas Bay	10	42	0	61	41	0
	— Port Spain	10	38	42	61	34	15
	— Icaque Point	10	4	0	61	59	30
	— Point Galeota	10	9	30	61	0	50
	— Point Galera	10	50	20	60	56	35

XXVI. THE EAST COAST OF AMERICA, FROM CAPE SABLE TO DAVIS'S STRAIT.

	Cape Sable	25	1	0	81	10	0
	Tortugas Bank (5 fms)	24	31	0	83	14	0
	Dry Tortugas,						
	— Bush Kay, Light	24	36	0	83	0	0
	Florida Reef, W. End	24	20	0	82	39	0
	Boca Grand, entrance	24	27	0	82	13	0
Florida Reefs.	Sand Kay, Light	24	25	30	81	58	0
	Cayo Huesco or						
	Thompson Island,						
	— West End, Light	24	32	0	81	54	0
	Looe Kay, Tower	24	33	30	81	30	0
	Bahia Honda, entr.	24	38	0	81	26	0
	Sombrero Kay	24	38	0	81	14	0
	Great Inlet, Lt. Vessel	24	57	0	80	30	0
	Kay Travernier	24	59	0	80	33	0
	Kay Rodrigues	25	5	0	80	29	0
	Kayo Biscayno, Light	25	43	0	80	9	0
	Cape Florida	25	46	0	80	4	0
	White Inlet	25	51	0	80	6	0
East Florida.	Grenville Inlet, entr.	26	49	0	80	0	0
	Hillsborough Inlet	27	14	0	80	8	0
	N. W. end of Maternillo Reef	27	34	0	79	9	0
	Cape Canaveral	28	17	0	80	25	0
	Mosquito Inlet	28	58	0	80	55	0
	Matanza Inlet	29	39	0	81	17	0
	St. Augustin, Light	29	54	0	81	25	30
	St. John's River, bar	30	21	0	81	32	30
	Nassau River, entr.	30	28	0	81	33	0
	Cumberland I., Light	30	45	0	81	38	30
	St. Simon's I., Light	31	10	0	81	33	0
South Carolina.	Doboy or Sapello, Lt.	31	25	0	81	20	0
	Sapello Sound, entr.	31	34	0	81	6	0
	St. Catharine's Sound, entrance	31	41	0	81	3	0
	Savanna, Town	32	4	30	81	1	0
	— entr., Tybee Light	32	0	0	80	51	0
	Beaufort	32	28	0	80	37	0
	Charleston, Town	32	45	34	79	50	30
	— Light	32	40	49	79	46	30
	Cape Roman, Light	33	0	0	79	17	0
	Georgetown	33	22	30	79	12	30
	— Light	33	10	0	79	2	40
North Carolina.	Cape Fear, S. E. Pt.	33	49	0	77	58	0
	— Lighthouse	33	51	15	78	1	40
	Frying Pan Shoals,						
	— Outer Shoal	33	36	0	77	50	0
	Wilmington, Light	33	58	0	77	58	0
	Beaufort, Town	34	43	0	76	45	0
	Cape Lookout, Light	34	39	0	76	37	0
	— Shoals, S. end	34	30	0	76	34	0

	(116) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Ocracock Inlet, Light	35	6	0	75	59	0
	Cape Hatteras, Light	35	15	0	75	30	0
	— Shoals, S. end	35	7	0	75	24	0
	New or Roanoke Inlet	35	37	0	75	26	0
	Currituck Inlet	36	26	0	75	51	0
	Cape Henry, Light	36	56	0	76	0	0
Virginia.	Cape Charles	37	7	30	75	58	0
	Norfolk	36	50	0	76	15	0
	New Point Comfort, Lt.	37	18	0	76	17	0
	Smith's Point, Light	37	51	0	76	16	0
	Cedar Point	38	14	0	76	22	0
	Annapolis	38	59	0	76	30	0
	Baltimore	39	18	0	76	36	0
	WASHINGTON	38	52	45	77	0	30
	Smith's I., Light	37	13	0	75	47	0
Delaware.	Cape Henlopen, Light	38	46	40	75	7	0
	Cape May, Light	38	57	0	74	55	45
	Dover	39	10	0	75	29	0
	Wilmington	39	45	0	75	30	0
	PHILADELPHIA	39	56	54	75	10	30
	Great Egg Hr., entr.	39	18	30	74	33	0
New Jersey.	Little Egg Hr., entr.	39	30	0	74	20	0
	Barnegat Inlet, entr.	39	47	30	74	7	0
	Sandy Hook, Light	40	27	40	74	2	0
	NEW YORK, Fort	40	42	10	74	2	30
	— City Hall	40	42	20	74	3	31
	Frog's Point, Light	40	48	0	73	50	0
	Sand Point, Light	40	51	0	73	46	0
	Eaton's Neck, Light	40	57	0	73	26	30
	Norwalle Island, Lt.	41	2	0	73	28	0
Long Island Sound.	Black Rock, Light	41	8	0	73	15	0
	Stratford Point, Light	41	8	0	73	9	0
	Old Field Point, Light	40	58	0	73	10	0
	New Haven, Light	41	14	0	72	57	0
	Falkner's Island, Lt.	41	12	0	72	42	0
	Saybrook, Light	41	15	0	72	25	0
	New London, Light	41	18	0	72	10	0
	Plumb I., Light	41	10	0	72	17	0
	Gull, Light	41	11	0	72	11	0
	Watch Hill, Light	41	17	0	71	56	0
	Stonington, Light	41	19	0	71	59	0
	Montock Point, Light	41	3	0	71	56	0
	Block I., Lights	41	13	0	71	40	0
	Point Judith, Light	41	22	0	71	31	30
	Beaver Tail, Light	41	26	0	71	27	0
	Rhode Island,						
	— Newport, Light	41	29	0	71	22	0
	Providence, Town	41	50	41	71	25	20
	Buzzard Bay, Light	41	24	0	70	59	0
Rhode Island.	Dumplin, Light	41	32	0	70	57	0
	New Bedford, Light	41	35	0	70	56	0
	Martha's Vineyard,						
	— Gay Head, Light	41	20	30	70	52	0
	— North Point, Light	41	28	30	70	37	0
	— Cape Poge, Light	41	24	30	70	27	0
	Point Gammon, Light	41	37	0	70	16	0
	Nantucket Island,						
	— Brant Town, Light	41	17	0	70	7	0
	— Sandy Point, Light	41	23	0	70	3	0
	Sancotty Head	41	16	0	69	58	0
	Nantucket South Sh.	41	4	0	69	55	0
	George's Shoals						
	— S. E. part	41	34	0	67	40	0
	— West part	41	42	0	67	59	0
	— N. E. part	41	48	0	67	47	0
	— North Shoal, mid.	41	53	30	67	43	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(117) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	George's Shoals,						
	— Shoal	41	51	0	67	26	0
	—Easternmost Shoal	41	47	0	67	19	0
	Chatham, Sandy Pt.						
Massachusetts.	— South End, Light	41	34	0	70	0	0
	Chatham Hr. Lights	41	41	0	69	57	0
	Cape Cod, Light	42	3	0	70	4	0
	Race Point, Light	42	4	0	70	12	0
	Long Point, Light	42	1	0	70	7	0
	Billingsgate I., Light	41	52	0	70	4	0
	Barnstaple, Light	41	44	0	70	18	0
	Plymouth, Lights	42	1	0	70	37	0
	Scituate, Light	42	12	0	70	43	0
	BOSTON,						
	— Outer Light	42	20	0	70	55	0
	— Long Island, Light	42	20	0	70	58	30
	— Town	42	22	11	71	4	0
	Salem	42	31	0	70	54	0
	Baker's Island, Lights	42	32	30	70	48	0
	Cape Ann,						
	— Thatcher's I. Lights	42	39	0	70	34	0
	Annisquam, Light	42	40	0	70	41	0
	Ipswich Hr. entrance	42	42	0	70	45	0
	Newbury Port,						
	— Plumb I., Lights	42	47	45	70	48	30
	Isles of Shoals,						
	— White Island, Light	42	58	0	70	37	0
	Portsmouth, Light	43	3	30	70	42	0
	Boon Island, Light	43	8	0	70	29	0
	Cape Neddock	43	10	0	70	35	0
	Cape Porpoise	43	21	0	70	27	0
	Wood Island, Light	43	27	0	70	19	0
Maine.	Casco Bay,						
	— Cape Elizabeth, Lts.	43	33	0	70	11	0
	— Portland, Light	43	36	30	70	11	30
	— Halfway Rock	43	37	0	70	1	0
	Cashes Ledge, middle.	43	2	0	69	6	0
	Seguin Island, Light	43	40	30	69	43	30
	Pond Island, Light	43	42	30	69	45	30
	Burnt I., Light	43	42	0	69	37	0
	St. John's Bay,						
	— Penmaquid Pt., Lt.	43	48	0	69	29	0
	Franklin's I., Light	43	53	0	69	20	0
	Manheigin I., Light	43	44	0	69	16	0
	Ball Rock, Light	43	47	0	68	49	0
	White Head, Light	43	57	0	69	4	0
	Owl's Head, Light	44	4	0	68	58	0
	Castine, Light	44	24	0	68	45	0
	Haute Island, S. Pt.	43	58	0	68	35	0
	Mount Desert Rock	43	51	0	68	6	0
	Baker's I., Light	44	13	0	68	7	0
	Petit Manan I., Light.	44	21	0	67	49	0
	Head Harbour, Light	44	28	0	67	31	0
	Libee Islands, Light	44	33	0	67	21	0
	Machias Town	44	41	0	67	23	0
	Passamaquady Hd. Lt.	44	48	0	66	56	0
New Brunswick.	Head Harbour, Light	44	56	50	66	52	58
	Grand Manan Island,						
	— North Point	44	46	49	66	45	7
	— South West Head	44	36	0	66	51	0
	— Grand Harb., ent.	44	39	0	66	43	0
	White Head I., S. Pt.	44	36	59	66	41	4
	Old Proprietor Rock	44	32	30	66	36	0
	Gannet Rock, Light	44	31	0	66	46	0
	Machias Seal Islands,						
	— N. E. part, Light	44	31	0	67	2	0

	(118) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	St. Andrew's, Town	45	3	30	67	1	0
	Wolf Islands,						
	— N. E. end	44	59	0	66	42	0
	Beaver Harbour, entr.	45	3	12	66	43	28
	Point Lepreau, Lights	45	4	0	66	27	0
	St. John's Town	45	15	0	66	2	19
	Partridge Island, Light	45	13	36	66	2	0
	Cape Maspeck	45	12	30	65	59	15
	Cape Spencer	45	12	0	65	53	0
	Quako, Light	44	19	0	65	25	0
	Quako Ledge, middle	45	15	30	65	11	0
	Cape Enrageé	45	30	0	64	33	0
	Fort Cumberland	45	44	0	64	9	0
	Cape Chignecto	45	18	0	64	49	30
	Cape Split.	45	17	30	64	22	0
	Haute Island	45	14	0	64	54	0
	Annapolis,						
	— Pt. Prim or Digby Light	44	40	25	65	46	15
	Bryer's Island, Light	44	13	51	66	22	54
	Cape St. Mary	44	4	15	66	11	0
	Cape Fourchu	43	48	0	66	9	0
	Gannet Rock	43	37	30	66	6	0
	Seal Island, S. Point	43	23	51	65	55	42
	— North Point	43	26	22	65	57	38
	Blond Rock	43	20	30	65	55	15
	Cape Sable, S. Point	43	23	57	65	34	3
	Var. 12° 24′ *W.*						
	Brazil Rock	43	21	30	65	22	0
	Cape Negro	43	31	0	65	18	0
	Shelburne	43	44	30	65	17	0
	Cape Roseway, Light	43	37	31	65	14	40
	Rugged Island, S.E. Pt	43	41	14	64	59	44
	Little Hope Island	43	48	34	64	45	48
Nova Scotia.	Mouton Island, S. Pt.	43	55	0	64	44	0
	Liverpool Bay,						
	— Western Head	43	59	13	64	38	35
	Liverpool, Coffin I., Lt.	44	1	52	64	36	49
	Var. 14° 43′ *W.*						
	Port Metway,						
	— South-west Head	44	6	24	64	31	9
	Indian Island	44	9	40	64	22	51
	Cape Le Heve	44	11	8	64	19	43
	Le Heve Rock	44	10	50	64	18	25
	Lunenburg Bay,						
	— Cross Island, S. Pt.	44	19	30	64	8	45
	— Point Rose	44	18	7	64	11	33
	Green Island	44	23	30	64	1	0
	Cape Prospect	44	26	38	63	42	39
	Sambro, Light	44	27	0	63	33	0
	HALIFAX,						
	— Naval Yard	44	39	26	63	33	48
	Var. 17° 10′ *W.*						
	Jedore Head	44	40	5	63	1	10
	Owl's Head	44	43	0	62	48	0
	Spry Harbour,						
	— Taylor's Head	44	46	0	62	29	0
	Outer Beaver I., S.E. Pt	44	48	24	62	17	43
	White Island, E. end	44	50	30	62	2	0
	Liscombe Harbour,						
	— South West Point	44	57	0	61	55	0
	Green Island, S. Pt.	45	4	55	61	14	49
	Berry Head	45	10	44	61	17	9
	White Head Island	45	10	17	61	5	49
	Cape Canso	45	16	0	60	56	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(119) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Cranberry Island, Lt.	45	19	33	60	54	38
	Sable Island, W. end	43	56	30	60	12	34
	— East end	43	59	15	59	46	17
	— Southernmost part	43	55	0	59	54	0
	——						
	Gut of Canso,						
	— Eddy Point . . .	45	30	25	61	12	51
	— Ship Harbour . .	45	36	25	61	17	43
	Isle Madame,						
	— Cape Hogan . .	45	27	0	61	1	0
	Green Island . . .	45	27	47	60	53	48
	Cape Portland . . .	45	47	57	60	3	36
	Cape Hinchinbroke .	45	34	29	60	38	36
	Louisbourg,						
Breton Island.	— Old Lighthouse .	45	53	31	59	55	48
	Cape Breton . . .	45	56	26	59	46	15
	Scateri Island, E. Pt.	46	1	19	59	39	29
	Cape Granby . . .	46	9	18	59	49	0
	Var. 22° 27′ *W.*						
	Flint Island . . .	46	10	0	59	47	0
	St. Ann's Bay,						
	— Siboux Is., S. end	46	24	20	60	25	30
	Naganish Island . .	46	44	0	60	22	0
	Cape North	47	2	13	60	22	53
	Chetican Harb., entr.	46	39	0	60	59	0
	Sea Wolf Island . .	46	22	30	61	14	0
	Just aux Corp I., S. Pt.	45	58	10	61	33	51
	Cape Linzee . . .	45	59	31	61	32	15
	Var. 21° 14′ *W.*						
	Port Hood, entrance .	45	58	0	61	30	0
	——						
Prince Edward's Island.	East Point	46	27	36	61	56	8
	George Town . . .	46	10	30	62	30	0
	Bear Cape	46	0	2	62	25	57
	Charlotte Town . .	46	16	0	63	10	0
	Cape Traverse . . .	46	13	37	63	38	47
	Cape Egmont . . .	46	26	0	64	7	0
	West Cape	46	37	48	64	20	21
	North Cape	47	4	20	64	0	15
	Richmond Bay, entr.	46	36	30	63	44	0
	New London . . .	46	33	0	63	32	0
	St. Peter's Harb., entr.	46	29	0	62	48	0
	——						
	Gut of Canso,						
	— North entrance .	45	42	0	61	26	0
	Cape St. George . .	45	51	22	61	51	12
	Merigomish Harb. ent.	45	40	0	62	26	0
	Pictou Island,						
	— South end . . .	45	47	52	62	33	33
New Brunswick.	*Var.* 19° 35′ *W.*						
	Pictou Harbour . .	45	41	56	62	38	0
	— Academy . . .	45	40	20	62	40	28
	Tatmagouche,						
	— Amet Island . .	45	49	0	63	8	0
	Cape Tormentin,						
	— N. E. Point . . .	46	7	38	63	47	42
	Richibucto Harb., ent.	46	44	0	64	47	0
	Miramiche Bay,						
	— Point Escuminac .	47	5	2	64	49	30
	Chaleur Bay,						
	— Point Miscou . .	48	1	27	64	31	49
	— Point Paspibiac .	48	0	54	65	4	17

	(120) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Chaleur Bay,						
	— Cape Despair . .	48	25	0	64	19	0
	Nipisighet Bay,						
	— Caron Point . .	47	37	0	65	31	0
	Bonaventure Island,						
	— N.W. Point. . .	48	29	30	64	9	37
	Flat Point	48	36	0	64	11	0
	Cape Gaspê, S. E. Pt.	48	45	14	64	9	38
	Var. 21° 38′ *W.*						
	Gaspé Bay,						
	— Douglas Town. .	48	46	33	64	21	18
	Cape Rosier . . .	48	50	41	64	11	24
	Magdalen River, entr.	49	13	0	65	6	0
	Cape Chat	49	6	0	66	48	0
	Bic Island	48	26	0	68	49	0
	Green Island, Light .	48	3	0	69	28	0
	Anticosta I., East Pt.	49	8	30	61	42	57
	Var. 24° 38′ *W.*						
	— South Point . .	49	4	0	62	18	0
Gulf of St. Lawrence.	— South West Point	49	23	0	63	41	20
	— Jupiter's R., entr.	49	28	0	63	43	0
	— West Point. . .	49	52	0	64	33	55
	Var. 22° 55′ *W.*						
	— North Point . .	49	57	38	64	11	1
	Magdalen Islands,						
	— North East Point .	47	37	37	61	22	51
	— Amherst I., S.W. Pt	47	12	0	62	5	0
	— Entry I., S.W. Pt.	47	16	7	61	43	26
	Var. 22° 25′ *W.*						
	— Deadman's Island	47	16	0	62	17	0
	Biron Island, N.E. Pt.	47	48	0	61	25	0
	Bird's Island . . .	47	50	28	61	11	53
	St. Paul's Island . .	47	13	38	60	11	24
	——						
	Cape Ray	47	37	3	59	17	2
	Cape Anguille . . .	47	55	0	59	24	20
	Cape St. George . .	48	28	54	59	14	26
	Bay of Islands,						
	— South Head . . .	49	6	12	58	20	32
	Cow Head	49	55	12	57	51	16
	Ingornachoix Bay,						
	— Port Saunders, ent.	50	38	30	57	18	0
	Point Riche . . .	50	41	30	57	24	0
	St. John's I., Bay .	50	47	30	57	16	0
Newfoundland.	Point Ferolle . . .	51	1	9	57	5	47
	Bay St. Barbe,						
	— Anchor Point . .	51	14	0	56	45	0
	Seal Islands . . .	51	17	0	56	43	0
	Green Island . . .	51	24	0	56	29	0
	Cape Norman . . .	51	37	0	55	48	0
	Burnt Cape	51	35	0	55	38	0
	Cape Onion . . .	51	36	30	55	31	0
	Quirpon Island,						
	— Cape Bauld . . .	51	38	0	55	30	0
	Belle Island, S. Point	51	52	26	55	19	30
	Griguet Bay . . .	51	32	30	55	21	30
	St. Lunaire Bay,						
	— White Cape . .	51	30	25	55	21	33
	Var. 32° 0′ *W.*						
	Braha Harbour,						
	— Needles Rocks .	51	26	5	55	22	45
	Var. 34° 0′ *W.*						

LATITUDES AND LONGITUDES.

	(121) Places.	Lat. N. °	′	″	Lon. W. °	′	″
	St. Anthony's Harb. .	51	21	0	55	28	0
	Goose Cape . . .	51	17	0	55	32	0
	Hare Bay,						
	— How Harbour . .	51	20	0	55	51	0
	— Hare Island . .	51	20	0	55	56	0
	Croc Harbour . . .	51	3	0	55	41	0
	Cape Rouge . . .	50	57	0	55	44	0
	Rouge Island, N. Pt.	50	54	0	55	42	0
	Groais Island, N. Pt.	50	59	0	55	27	0
	Belle Island, N. Point	50	48	0	55	23	0
	Green Island . .	50	44	0	55	35	0
	Canada Head . . .	50	41	0	56	2	0
	Spear Point. . . .	49	44	0	56	45	0
	Partridge Point . .	50	9	30	56	4	0
	Fleur de Lis Harbour	50	6	40	56	2	10
	Pacquet Harbour . .	49	58	30	55	45	0
	La Scie Harbour . .	49	58	0	55	30	30
	Cape St. John,						
	— North Bill . . .	49	59	30	55	25	0
	Gull Island . . .	49	59	30	55	16	0
	Nipper's Harbour,						
	— Seal Island, E. Pt.	49	47	0	55	46	8
	Var. 28° 0′ *W.*						
	Ring Island,						
	— Cutwell's Harbour	49	37	0	55	34	0
Island of Newfoundland.	Triton Harbour,						
	— Francis Island . .	49	33	0	55	31	0
	Fortune Harbour . .	49	32	0	55	10	0
	Toulinguet Harbour,						
	— Harbour Rock . .	49	39	28	54	41	20
	Var. 30° 0′ *W.*						
	Change Islands,						
	— Tobacco Island .	49	41	35	54	18	10
	Fogo Island, Harbour						
	-- Lanes I., E. Point	49	44	25	54	11	30
	— Cape Fogo . . .	49	40	0	53	54	0
	Wadham Islands,						
	— Offer Wadham . .	49	37	30	53	40	0
	Funk Island . . .	49	44	21	53	7	20
	Cape Freels,						
	— South Bill . . .	49	18	40	53	24	0
	Greenspond Island .	49	7	30	53	31	0
	Offer Gooseberry I. .	48	58	30	53	27	0
	Barrow Harbour . .	48	39	0	53	34	0
	Black Head Bay,						
	— Southern Head .	48	37	15	53	16	0
	Young Harry Reef .	48	48	5	52	58	15
	Cape Bonavista,						
	— Gull Island . . .	48	42	40	52	59	20
	CatalinaHarb.N.Head	48	32	28	52	56	6
	Horsechops	48	21	30	53	8	30
	Trinity Harbour, entr.	48	21	30	53	16	50
	Bonaventure Head .	48	16	30	53	18	10
	Bacalieu Island, N. Pt.	48	9	0	52	44	46
	Cape St. Francis . .	47	48	4	52	43	41
	St. John's Harb. Ch.	47	34	35	52	38	37
	Cape Spear	47	30	53	52	33	30
	Bull Head	47	18	0	52	41	19
	Cape Broyle, N. Pt. .	47	3	52	52	47	27
	Cape Ballard . . .	46	46	46	52	53	20
	CAPE RACE	46	39	44	52	59	10
	Virgin Rocks . . .	46	26	33	50	56	35

	(122) Places.	Lat. N. °	′	″	Lon. W. °	′	″
	Trepassey Bay,						
	— Cape Pine . . .	46	37	14	53	30	0
	Point Lance . . .	46	47	0	54	0	0
	Cape St. Mary . . .	46	49	25	54	8	45
	Point Breme . . .	46	58	0	54	11	0
Island of Newfoundland.	Placentia Harbour .	47	15	11	53	55	3
	Little Southern Harb.	47	43	32	53	54	38
	Bordeaux Harbour .	47	45	28	53	58	30
	Mortier Bay, entrance	47	4	30	55	1	0
	Mortier Rocks, mid. .	47	2	0	54	52	0
	Cape Chapeaurouge .	46	54	19	55	20	30
	Point May	46	54	0	55	59	0
	St. Peter's I., Lighth.	46	46	52	56	8	44
	Little Miquelon, S.Pt.	46	47	0	56	19	0
	Cape Miquelon . .	47	8	11	56	19	30
	Connaigre Shoal . .	47	23	57	55	57	19
	Pass Island	47	29	2	56	11	13
	Outer Penguin Is. .	47	22	9	56	58	7
	Cape La Hune . . .	47	31	55	56	50	23
	Burgeo Is., Eclipse I.	47	36	6	57	36	15
	Connoire Bay . . .	47	40	0	58	0	0
	QUEBEC obs. . . .	46	49	8	71	15	43
Canada.	Coudre I., N.E. Point	47	25	0	70	13	0
	St. Paul	47	26	0	70	22	0
	Malbay	47	37	0	70	3	0
	Bay of Rocks . . .	47	57	0	69	43	0
	Point Mille Vache .	48	32	0	69	5	0
	Manicougan Point .	49	6	0	68	5	0
Esquimaux.	Bold Mountain's Pt. .	49	19	0	67	10	0
	The Seven Islands,						
	— Carousal Island .	50	5	0	66	11	0
	Mingan Island . . .	50	12	0	64	10	0
	Esquimaux Islands,						
	— St. Genevieve I. .	50	16	0	63	1	0
	Mount Joli	50	6	0	61	37	0
	Little Mecatina . .	50	50	0	59	15	0
	Great Mecatina Point	50	44	28	58	59	27
	Green Island . . .	51	24	0	57	11	0
	Forteaux Point . .	51	27	0	56	54	0
	Ship Head	51	37	0	56	38	0
	Red Bay,						
	— Saddle Island . .	51	42	40	56	21	0
	York Point	51	55	0	56	42	0
	Belle Island, S.W. Pt.	51	52	26	55	19	31
	— N. E. Point. . .	52	0	33	55	11	30
Labradore.	Cape Charles . . .	52	12	18	55	31	1
	Sandwich Bay,						
	— Huntingdon Island	53	50	0	56	30	0
	Nain	56	24	0	61	48	0
	Port Manvers . . .	56	58	0	62	0	0
	Var. 41° 15′ *W.*						
	Button's Isles . . .	60	45	0	64	55	0
	Resolution I., S. Pt. .	61	20	40	64	55	15
Hudson's Strait.	Cape Resolution . .	61	39	0	64	30	0
	LowerSavage Is., S.Pt.	61	40	0	66	7	0
	Saddleback Island . .	62	11	0	67	43	0
	Upper Savage Islands	62	32	30	69	58	0
	SalisburyIsland, N.Pt.	63	47	0	77	13	0
	King's Cape . . .	64	23	0	77	46	0
	Trinity Islands . .	64	27	0	78	8	0
	Cape Comfort . . .	64	54	0	82	57	0

TABLE LVI.

LATITUDES AND LONGITUDES.

	(123) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
Frozen Strait.	Cape Welsford . .	65	28	0	84	40	0
	Var. 50° 18′ *W.*						
	D. of York's Bay, anch.	65	19	0	85	1	0
	Cape Frigid . . .	65	59	30	85	25	0
	Repulse Bay . . .	66	30	58	86	30	20
	Var. 48° 33′ *W.*						
	Cape MacLaren . .	66	9	40	84	2	40
	Cape Martineau . .	66	9	30	83	54	20
	Vansittart I., N.E. Pt.	66	7	10	84	16	0
	Baffin's I., S. E. Pt. .	65	40	0	83	29	0
	Winter Island, S. Pt.	66	11	25	83	10	0
	Var. 56° 18′ *W.*						
	Lyon Inlet,						
	— Cape Edwards . .	66	18	40	83	38	30
	Owlitteweek Island .	66	58	30	81	36	0
	Var. 62° 17′ *W.*						
	Barrow River, entr. .	67	18	0	81	25	0
	Var. 70° 28′ *W.*						
	Cape Penrhyn . . .	67	24	40	81	19	0
	Cape Jermain . . .	67	47	30	81	58	30
	Ooglet Island, S. Pt. .	68	23	0	81	32	0
	Igloolik I., S.E. Point	69	20	40	81	31	0
Fury and Hecla Strait.	Neirloonakto I., N.Pt.	69	33	0	81	41	0
	Var. 87° 20′ *W.*						
	Bouverie Is., E. Pt. .	69	36	30	82	1	0
	Var. 88° 51′ *W.*						
	Liddon's I., S. Point	69	45	0	83	6	0
	Amherst I., N. E. Pt.	69	48	0	83	35	0
	Var. 89° 18′ *W.*						
	Cape Hallowell . .	69	57	40	85	25	0
	Cape Englefield . .	69	51	0	85	30	0
	——						
	C. Wolstenholm or Walsingham. . .	62	39	0	77	48	0
	Cape Digges . . .	62	41	0	78	50	0
	Salisbury Island . .	63	29	0	76	47	0
	Mansfield Island,						
	— North Point . .	62	38	30	80	33	0
	— South Point. . .	61	35	0	81	0	0
	Cape Southampton .	61	56	0	83	52	0
	Cape Pembroke . .	62	57	0	81	15	0
Hudson's Bay.	North Sleepers . . .	61	0	0	78	15	0
	West Sleepers, N. end	60	15	0	81	35	0
	Portland Point . . .	59	0	0	78	30	0
	Belchers, N. Point .	56	20	0	80	15	0
	James's Bay,						
	— C. Henrietta Maria	55	10	0	82	30	0
	— Cape Jones . . .	54	50	0	78	54	0
	— Bear Isle . . .	54	34	0	81	24	0
	— North Cubb . .	54	20	0	80	48	0
	— The Twins . . .	53	12	0	80	35	0
	— Albany Fort . .	52	14	40	82	0	0
	— Moose Fort . . .	51	15	54	80	56	24
	— East Main House .	52	15	0	78	44	30
	— Charlton Island .	52	3	0	80	8	0
	York Factory . . .	57	0	3	92	26	0
	Cape Churchill . .	58	50	0	93	4	0
	Fort Churchill . . .	58	47	32	94	13	55
	Marble Island . . .	62	33	0	91	6	0
	Sir T. Rowe's Welcome						
	— Cape Fullerton .	63	50	0	88	15	0
	— Cape Kendall . .	63	40	0	87	15	0

	(124) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Bay of God's Mercy .	63	35	48	86	32	0
	——						
	Charles Island . . .	63	0	0	64	50	0
	Cape Enderby . . .	63	45	0	65	30	0
	Sanderson's Tower .	64	50	0	63	44	0
	Cape Mickleham . .	65	18	0	62	50	0
	Cape Dacres . . .	65	36	0	61	50	0
Davis's Strait	Cape Walsingham .	66	4	0	60	51	0
	Mount Raleigh . .	66	30	0	61	30	0
	Dyer's Cape . . .	66	42	0	61	6	0
	Cape Broughton . .	67	47	0	63	30	0
	Cape Hooper . . .	68	6	0	64	36	0
	Cape Bisson . . .	69	10	0	66	50	0
	Cape Kater	69	42	0	67	25	0
	Cape Roper . .	70	5	0	67	20	0
	River Clyde,						
	— Cape Hewett . .	70	27	0	67	58	0
	— Agnes Monument .	70	37	0	68	0	0
	Cape Eglinton . . .	70	49	0	69	10	0
	Scott's Bay	71	10	0	71	10	0
	Cape Bowen . . .	72	25	0	74	40	0
	Cape Graham Moore .	72	54	0	76	5	0
	Cape Byam Martin .	73	25	0	76	40	0
	Var. 96° *W.*						
	Cape Liverpool . .	73	44	0	78	10	0
	Cape Hay	73	50	0	79	55	0
	Lancaster Sound,						
	— Entrance, about .	74	19	0	80	0	0
	Wollaston Islands . .	73	49	0	80	57	0
	Cape Charles York .	73	53	0	82	52	0
	Cape York	73	50	0	86	55	0
	Prince Regent's Inlet						
	— Port Bowen . . .	73	13	39	88	54	49
	Var. 123° 22′ *W.*						
	— Neill's Harbour .	73	9	8	89	1	20
	Var. 118° 48′ *W.*						
	— Cape Kater . . .	71	55	0	90	5	0
	— Cape Garry . . .	72	23	0	93	17	0
	— Fury's Wreck . .	72	42	30	91	50	5
	— Cape Sepping . .	73	47	0	90	15	0
	Prince Leopold's Is.,						
	— East end . . .	74	2	0	89	50	0
	Griffith's I., S. E. Pt.	74	31	0	95	21	0
	Lowther Island, S. Pt.	74	27	30	97	47	0
	Bathurst Island,						
	— Cape Cockburn .	75	3	0	100	25	0
	Byam Martin Island,						
	— Cape Gillman . .	75	3	0	104	10	0
	Melville Island,						
	— Hecla and Griper B. Winter Har., obs.	74	47	10	110	48	15
	Var. 127° 48′ *E.*						
	— Cape Dundas . .	74	27	50	113	57	35
	— Liddon's Gulf, entrance, about .	75	2	0	113	0	0
	Cape Hurd	77	42	0	78	47	0
	Cape Bullen . . .	74	22	0	84	45	0
	Cape Warrender . .	74	27	0	81	40	0
	Cape Horsburgh . .	74	55	0	78	40	0
	Cape Leopold . . .	75	40	0	78	5	0
	Cape Clarence . . .	76	45	0	77	40	0
	Var. 107° *W.*						

TABLE LVI.

LATITUDES AND LONGITUDES.

	(125) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Hackluyt's Islands .	77	26	0	73	40	0
	Carey's Islands . .	76	49	0	73	10	0
	Cape Parry	77	6	0	71	23	0
	Arabella Rock . . .	76	34	0	70	34	0
	Wolstenholme S. ent.	76	29	0	70	0	0
	Dalrymple Rock . .	76	28	0	70	42	0
	Wolstenholme Island	76	24	0	70	22	0
	Cape Dudley Digges	76	5	0	68	54	0
Baffin's Bay.	Cape York	75	55	0	66	38	0
	Bushnan's Island . .	76	4	0	65	28	0
	Cape Melville . . .	76	3	0	64	30	0
	Var. 90° 18′ *W.*						
	Skene's Islands . .	76	5	0	63	24	0
	Cape Walker . . .	75	46	0	59	54	0
	Sabine's Islands . .	75	26	0	60	9	0
	Cape Seddon . . .	75	15	0	59	10	0
	Baffin's Islands . .	74	37	0	57	35	0
	Devil's Thumb . .	74	16	0	57	56	0
	Upernavik	73	25	0	57	26	0
	Vrow or Woman's Is.	72	45	0	56	40	0
	Black Hook	71	27	0	55	31	0
	Four Islands, Point .	70	46	0	54	3	0
	Waygat or Hare I.,						
	– N. E. side . . .	70	26	17	54	51	49
	Disco Island, N. end	70	12	0	55	0	0
	— S. E. Road . . .	69	7	0	53	30	0
	— Lievely Bay . .	69	10	0	54	30	0
	Whale Islands,						
	— KronPrin'sFactory	68	58	0	53	13	0
Davis's Strait.	*Var.* 70° 24′ *W.*						
	Cape Chidley . . .	68	37	0	53	33	0
	Savage Islands . . .	67	44	0	53	40	0
	Queen Ann's Cape .	66	26	0	53	20	0
	Victorious Rock . .	66	21	0	53	47	0
	Coquin Sound . . .	65	38	0	53	0	0
	Mosquito Cove . .	64	55	13	52	56	45
	Godt-haab	64	9	55	51	50	0
	Lichtenfield . . .	62	59	0	51	18	0
	Cape Farewell . . .	59	49	12	43	53	40

XXVII. The Coasts of EAST GREENLAND, ICELAND, and SPITZBERGEN, with the adjacent Islands.

	Staten Hook . . .	59	38	0	44	30	0
	Cape Barclay . . .	69	13	0	24	25	0
	Scoresby's Sound,						
	— Cape Brewster . .	70	11	0	22	0	0
	— Cape Tobin . . .	70	26	0	21	55	0
East Greenland.	— Cape Stewart . .	70	28	0	22	36	0
	Rathbone I., E. end .	70	40	0	21	15	0
	Cape Gladstone . .	71	33	0	21	38	0
	Smith's Island . . .	71	49	0	22	17	0
	Cape Moorsom . . .	72	11	0	21	51	0
	Cape Parry	72	27	0	21	45	0
	Bontekoe I., E. end .	73	7	0	21	18	0
	Cape Freycinet . .	72	45	0	22	30	0
	Cape Broer Ruys . .	73	33	0	20	28	0
	Jackson's I., S.E. Pt.	73	58	0	19	55	0
	GaelHamke'sBay,ent.	74	5	0	20	0	0
	Cape Borlase Warren	74	15	0	19	21	0

	(126) Places.	Lat. N.			Lon. W.		
		°	′	″	°	′	″
	Pendulum Is., S. Pt. .	74	32	19	18	50	0
	— Cape Desbrowe .	74	40	0	18	20	0
	Shannon Island,						
	— Cape Philip Broke	74	56	0	17	22	0
	— N. E. Point . . .	75	14	0	17	0	0
	Jan Mayen's Island,						
	— N. E. Point . .	71	8	20	7	25	48
	— English Bay . .	71	0	0	8	9	0
	— South Cape . . .	70	49	0	8	44	0
	— S. E. Cape . . .	7	1	30	7	29	0
	——						
	Portland Isle . . .	63	22	0	18	54	0
	Cape Hecla	63	32	0	20	16	0
	Cape Reikianess . .	63	55	0	22	47	45
	Reikiaviig, Road . .	64	9	0	21	51	30
Iceland.	Bessestæd	64	6	9	21	53	34
	Lambhuus	64	6	17	21	55	30
	Patrix Fiord . . .	65	35	45	24	9	53
	North Cape	66	44	0	22	44	0
	Holum	65	44	0	19	44	0
	Grim's Island . . .	66	57	0	19	12	0
	Langanes	66	22	0	16	6	0
	Enkuysen Island . .	64	54	0	10	28	0
	——					East	
	Little Table Island .	80	48	0	20	25	0
	Walden Island . . .	80	35	0	19	51	0
	Var. 17° 42′ *W.*						
	Black Point	80	29	0	19	26	0
	Low Island, W. Pt. .	80	18	0	18	10	0
	Shoal Point	80	12	0	17	52	0
	Verlegen Hook . .	80	2	0	16	32	0
	Treurenburg Bay,						
	— Hecla Cove . . .	79	55	8	16	48	45
	Var. 18° 46′ *W.*						
	Cape Fanshawe . .	79	37	30	18	17	0
Spitzbergen and adjacent Islands.	Mussell Bay . . .	79	52	0	15	42	0
	Grey Hook	79	48	0	14	56	0
	Moffen Island, N. Pt.	80	1	0	14	38	0
	Flat Hook	79	50	30	11	56	0
	Fair Haven, entrance	79	49	0	11	25	0
	Vogel Sang, N. end .	79	52	0	11	25	0
	Foul Point	79	47	0	11	20	0
	Amsterdam Island,						
	— Hakluyt's Head .	79	47	0	10	54	0
	Smeirenburg . . .	79	42	30	11	7	0
	Dane's Island, S. Pt.	79	37	0	10	52	0
	Var. 24° 30′ *W.*						
	Magdalena Bay, entr.	79	33	0	10	45	0
	Hamburgher's Bay .	79	28	0	10	45	0
	Cross Bay, Mitre Cape	79	10	0	11	26	0
	King's Bay, S.W. Cape	78	56	0	11	33	0
	Charles' I., N. end .	78	53	0	10	32	0
	— Middle Hook . .	78	36	0	10	50	0
	Ice Sound, entrance .	78	9	0	14	1	0
	Bell Sound, entrance .	77	35	0	14	57	0
	Horn Sound, entrance	77	2	0	16	15	0
	Horn Mount . . .	76	58	0	16	35	0
	South Cape or						
	Point Lookout . .	76	39	0	17	20	0
	Hope Island, N.E. Pt.	76	33	0	22	7	0
	— S.W. Point . . .	76	20	0	20	40	0
	Bear or Cherie Island	74	30	0	19	5	0

TABLE LVII.

THE TIMES OF HIGH WATER.

On the Full and Change of the Moon, at the principal Ports, and along the Coasts, particularly of Great Britain and Ireland, with the vertical rise of the Tide in Feet at the Spring Tides.

Places.	Situation.	Times.		Rise.
		h.	m.	Feet.
A.				
Abaco	Bahamas	8	0	3
Abd-ul-Kuri	Indian Ocean	4	30	8
Aberdeen	Scotland	1	0	12
Aberdovy	Wales	8	0	15
Abrolhos	Brazil	4	48	6
Acapulco	Mexico, W.C.	3	6	1¼
Acheen Head	Sumatra	8	45	8
Achillbeg	Ireland	5	14	10¾
Adelaide Port	Australia, SC.	5	44	6
Aden	Arabia, SEC.	9	45	7
Adenara	Flores, Malay Archipelago			8
Agnes (St.)	Scilly Islands	4	30	16
Agoada Point	Hindostan, W. Coast.	10	30	9
Aix, Ile d'	France	3	20	17
Akaroa Harbour	New Zealand	3	24	8
Akyab	Bay of Bengal	9	45	9
Albemarle, Port	Falkland Ids	7	15	7
Aldborough	England	10	45	8
Alderney Island	Eng. Channel	6	46	17
Algoa Bay	Africa, S. Co.	4	0	4–5
Altona	Germany	5	19	7
Amboyna	Moluccas	0	33	7
Ameland Island	Netherland	11	30	7
Amiranté Island	Indian Ocean	5	0	8½
Amlwch	Wales	10	30	18
Amoy, (Inner Hrb.)	China, E. Co.	12	0	16
Amsterdam	Indian Ocean	11	0	3
Andaman Island, Port Cornwallis.	Indian Ocean	10	0	8¾
Andrava Bay	Madagascar	3	30	7
Angra	Azores	12	32	4½
Angra Pequena	Africa, SWC.	2	30	8
Annapolis	Nova Scotia.	11	0	30
Annapolis	United States	4	38	1
Anticosti Island, West Point	Gulf of St. Lawrence.	2	0	6
Antongil Bay	Madagascar	4	0	5
Antonio, Cape St.	Cuba	9	30	1½
Antonio, Port St.	Patagonia	10	40	28
Antwerp	Belgium	4	25	15
Aor Pulo	Sumatra NEC			5
Apalachicola Bay	Gulf Mexico			4
Arbroath	Scotland	1	35	14
Arcachon	France	4	37	11¾
Arcas Rocks	Gulf Mexico	Noon.		1½
Ardglass	Ireland	11	0	16
Ardrossan	Scotland	11	45	10
Arica Road	Peru	8	0	5
Arkhangel	White Sea	7	28	2½
Arklow	Ireland	8	45	4
Arnhem Bay	Australia	8	0	6–8
Arthur, Port	Tasmania	7	52	4
Arundel Bar	England	11	35	
Asaph (St.) Bay	Australia	5	45	14
Ascension Island	Sou. Atlantic	5	30	2
Auckland Harbour	NwZeal. N. Is.	7	5	11
Augustine (St.) Bar	United States	8	32	5
Augustine (St.) Bay	Madagascar	4	30	13
Avatcha Bay	Kamschatka	3	30	6¼
Ayr	Scotland	11	50	8¾
B.				
Bab-el-Mandeb	Persian Gulf	12	30	
Bahia	Brazil	3	30	8
Balade Harbour	N. Caledonia	6	30	
Balambaugan Isld.	Borneo	10	0	7
Balasore River	Bay of Bengal	10	0	15
Balbriggan	Ireland	10	40	11
Ballinskellig Bay	Ireland	3	40	12
Ballycastle Bay	Ireland	6	8	4
Ballyshannon Bar	Ireland	5	18	11¼
Balta	Scotland	9	45	6
Baltimore	Ireland	4	23	10¼
Banana Island	Africa, W. Co.	8	15	9
Bancoot River	Hndstn. WCo	2	0	12
Banda	Moluccas	4	0	6
Banff	Scotland	0	28	10½
Bantam	Java			5
Bantry Harbour	Ireland	3	47	10
Barbara, Port	Patagonia, W. Coast.	12	28	6
Barbe (St.)	Sumatra NEC	6	0	6
Bardsey, Island	Wales	7	40	15
Barfleur	France	8	51	17
Barmouth	Wales	7	41	17
Barnstable	United States	11	0	9
Barnstaple Bar	England	5	30	19
Barren Islands	Madagascar	4	45	12
Bas, Ile de	France	4	49	23
Bassein River	Bay of Bengal	10	0	9
Batanes, Bashee Ids.	China, E. Co.			4
Batchian, Gilolo	Moluccas	1	0	6
Bate (Gulf of Cutch)	Hindostan	12	20	12
Bathurst	Gulf St. Law.	3	15	7
Baticolo River	Ceylon	5	0	2–3
Bay of Islands	New Zealand	7	15	9
Bayonne (Bar)	France	3	45	12
Beachy Head	England	11	20	20
Bear Cape	P. Edward's I.	9	0	6
Beaufort	United States	7	26	3¼
Beaumaris	Wales	10	32	21½
Beaver Harbour	AmrcaNWCo	1	15	15½
Belfast	Ireland	10	43	9½
Bell Sound	Spitzbergen	8	56	3¼
Bembatooka Bay.	Madagascar	4	30	16
Bembridge Point	England	11	0	14
Bencoolen	Sumatra	6	0	3–5

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise.
		h.	m.	Feet.
Benin River	Africa, S. Co.	4	30	7
Berbice	Guayana ...	4	30	11
Bergen	Norway	1	30	4
Bermudas, Ireland Island	North Atlan.	7	14	4
Berwick	Scotland ...	2	18	15
Bic Island	Gulf St. Law.	2	15	14
Bilbao Bar	Spain	3	0	13
Blakeney Bar	England......	6	30	15
Blanco (Cape)......	Africa, W. Co.	11	46	6
Blewfields	Mosquito Co.	1	50	2
Block Island	United States	7	36	3½
Blyth	England......	3	15	15
Bodega	California ...	11	17	4¾
Bojador (Cape) ...	Africa	12	0	8
Bolt Head	England......	5	45	15
Bombay (Dk. Yd.)	Hindostan ...	11	40	12-17
Bonacca Island ...	Bay of Hond.	9	0	1½
Bonny R. C.	Africa, W....	5	0	9
Bordeaux	France	6	50	14
Borkum Road ...	Germany ...	10	30	8–10
Boston Sluice	England......	7	0	12
Boston, Charleston Yard	United States	11	27	11½
Boston Light	United States	11	12	11
Botany Bay.........	Austral., E. C.	8	15	7–8
Boulogne	France	11	25	25
Bow Island	South Pacific	2	40	3
Bowen Port	Australia ...	9	35	16
Boyanna Bay	Madag., W.C.	4	30	15
Bravo	Africa, E. Co.	4	30	8
Bray Head	Ireland	10	45	12
Bréhat	France	5	51	31
Brest	France	3	47	19
Bridgewater Bar...	England......	6	50	35
Bridlington	England......	4	39	16
Bridport	England......	6	5	11¼
Brielle	Netherlands .	3	0	5
Brighton	England......	11	15	19¾
Bristol (King Rd.)	England......	6	56	44
British Sound	Madag., E.C.	4	0	9½
Broad Sound	Austral., E.C.	11	0	20-30
Broadhaven Har...	Ireland	5	0	10½
Broken Bay.........	Austral., E.C.	8	0	6–9
Brouwershaven ...	Netherlands .	2	15	10
Bruni River.........	China, E. Co.	11	0	12
Buenos Ayres	Sou. America	Noon		Irreg
Bulama Island, Arcas Channel. .	Africa, W. C.	10	10	14
Bulsaur River	Hindost., WC	1	45	18
Buncranna	Ireland	5	40	16
Burntisland	Firth of Forth	2	24	16¼
Bushire River	Persian Gulf	7	40	5½
Bussorah Riv. Bar	Persian Gulf.	12	0	
Button Islands ...	Hudson Strait	6	50	
Byron Cape.........	Austral., E. C.	9	45	6
C.				
Cadiz	Spain	1	45	9½
Caen	France	10	57	
Caermarthen Bar..	Wales	6	10	26
Caernarvon	Wales	9	33	13¾
Cajeli Bay	Bouro	1	0	6
Calais	France	11	49	19½
Calcutta	Bengal	2	30	
Caldy Island	Bristol Chan.	6	0	24
Calebar Rio.........	Africa, W. Co.	5	0	9
Caledonia Harbour	New Granada	11	40	1½
Calf Sound	Isle of Man .	11	17	16¼
Callao Bay	Peru	5	47	4
Camaguin	Babuyan Is..	6	0	6
Cambing	Banda Sea...	Noon		6
Cameroon Rio	Africa, W. Co.	4	0	6
Campbell, (Cape)..	New Zealand	6	0	8
Campbell Island ...	South Pacific	12	0	43
Campbell Town ..	Gulf St. Law.	4	0	10
Campbellton	Scotland ...	11	45	8½
Campobello	Bay of Fundy	11	19	21
Cancale Bay	France	6	20	37
Canso Gut	Nova Scotia .	9	10	4½
Canso Harbour ...	C. Breton Is.	7	48	6½
Canton, (City).....	China.........	2	40	
Cape Coast Castle.	Africa, W. Co.	4	30	6
Capricorn Group...	Austl., E. Co.	8	0	7
Cardiff	Wales	6	59	38
Cardigan	Wales	7	1	12
Cardagos Garayos Shoals	Indian Ocean	2	0	4
Carlingford Bar ...	Ireland	10	40	17
Carlisle, (Port) ...	England......	12	10	20
Carlos, (St.) Port..	Patag., W.Co.	11	15	6
Cartagena	New Granada	11	0	1½
Carteret, (Port) ...	France	6	25	31
Casquets	Eng. Channel	6	45	15
Castlereagh, (Cape)	Tierra del Fuego ...	2	50	4
Catharina, (St.) Pt.	Brazil.........	2	30	3
Catoche, (Cape) ...	Yucatan ..	9	30	1
Cayenne	Guayana ...	3	45	6
Cayeux	France	11	5	27½
Ceuta	Africa, N. Co	2	6	3¾
Champion Bay ...	Austl., W.Co.	9	10	1
Charles, (Cape) ...	United States	7	45	5
Charleston	United States	7	13	6¼
Charlotte Town ...	Prince Ed. Is.	10	45	9½
Chatham	England......	1	2	17½
Chatte, (Cape) ...	United States	12	0	13
Chausey Islands ..	France	6	9	35
Cheduba	Bay of Bengal	11	30	8
Chepstow	England.....	7	30	38
Cherbourg	France	7	49	17
Chester	England......	10	30	26
Chichester	England......	11	30	
Chignecto, (Cape) .	Bay of Fundy	11	0	32
Chimmo Bay	China, E. Co.	10	20	16
Chinchew Harbour	China, E. Co.	12	25	17
Chinhae, (Yung R.)	China, E. Co.	11	20	12½
Chittagong Bar ...	Bay of Bengal	1	15	15
Chosan Harbour...	Japan Sea ...	7	45	7
Christchurch	England......	9 11	0 30	5
Christmas Island...	Indian Ocean	10	0	
Christmas Harbour	Kerguelen Is.	2	0	2
Chusan, Ting Hae.	China, E. Co.	11	0	12

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet.
Circular Head	Tasmania	12	0	9
Clara Sta. Island	Ecuador	4	0	11
Clear, (Cape)	Ireland	4	0	9
Cobija Bay	Bolivia	9	54	4
Cochin Harbour	Hindostan	1	0	3½
Cockburn, (Port)	Africa, E.Co.	4	15	12
Cod, (Cape)	UnitedStates	11	30	13
Colarados Rio	La Plata	3	40	11
Columbia Rio	Amer.,NWC.	0	15	7½
ComoroI.(Johanna)	Indian Ocean	3	30	8½
Condore	Cochin China	3	0	4
Conquet Road	France	3	46	21
Coquet Road	England	3	0	14½
Coquimbo Bay	Chili	9	8	5
Cordouan Lighthse.	France	3	37	13¾
Coringah Bay	Bay of Bengal	9	10	4
Corisco Bay	Africa, W.Co	5	0	7
Cork, (Quay)	Ireland	4	58	12¾
Cornwall, (Cape)	England	4	35	18
Corunna	Spain	3	0	15
Cowes, (West)	England	10 11	45 45	12½
Coy Inlet	Patagonia	9	30	40
Crane Island	R.St.Lawren.	5	24	17
Croc Harbour	Newfoundld.	6	30	4
Cromarty	Scotland	11	56	14
Cromer	England	7	0	14¾
Crooked Island	Bahamas	7	0	2½
Crookhaven	Ireland	4	9	9¾
Cuckold's Point	RiverThames	1	45	19
Cumberland Basin.	Bay of Fundy	11	48	50
Curieuse	Seychelles, Ind. Ocean	5	10	7
Curtis, (Port)	Austral.,E.C.	9	40	10-12
Cuxhaven	Germany	1	8	10
D.				
Dalrymple, (Port)	Tasmania	12	5	10
Damaun Bar	Hindostan	1	30	17
Dampier Strait	Moluccas			11
Darnley Island	Torres Strait	9	30	12
Dartmouth	England	6	16	14
Darwin, (Port)	Australia	5	30	17-24
Dauphin, (Fort)	Madagascar	4	30	7
Deal	England	11	15	16
Delagoa Bay, Port Melville	Africa, S. Co.	4	30	15
DelawareBreakwtr.	United States	8	0	4½
Delgado, (Cape)	Africa, E. Co.	4	0	16
Delhi, River	Sumatra	4	0	8
Demarara, River	Guayana	4	45	9
Desire, Port	Patog., E. Co.	12	10	8½
Devonport Dk. Yd.	England	5	43	15½
Diamond Island	Bay of Bengal	10	30	8
Diamond Point	Malacca Strt.	12	0	9½
Diego, San (Cape).	Terr.delFueg.	4	30	10
Diego,San,Garcia I.	Indian Ocean	1	30	6
Dielette	France	6	40	27
Dieppe	France	11	6	27
Dingle	Ireland	3	51	10¾
Discovery, Port	Amer.,NWC.	2	30	7
Dislocation Harb.	Terr.delFueg.	1	40	4
Diu Island	Hindostan	2	0	6
Divy Point	Bay of Bengal			5
Doboy Lighthouse.	United States	7	33	7¾
Donaghadee	Ireland	11	13	11¼
Donegal Harbour	Ireland	5	18	11½
Douglas	Isle of Man	11	12	20¾
Dover	England	11	12	18¾
Dragon's Mouth	CaribbeanSea	3	0	4
Dublin, (Bar)	Ireland	11	12	12-14
Dunbar	Scotland	2	8	14½
Duncansby Ness	Scotland	10	14	10
Dundalk	Ireland	10	56	13¼
Dundee	Scotland	2	32	14½
Dungeness	England	10	45	21¾
Dunkerque	France	12	8	16¾
Dunmore	Ireland	5	27	12¼
Durnford, Port	Africa, E. Co.	4	45	12
Dusky Bay	New Zealand	11	15	10
E.				
Easter Island	South Pacific	2	0	
Edgar, Port	Falkland Is.	7	15	6
Egg Island Lightho.	United States	9	4	7
Egg Island	Gulf St. Law.	2	0	11
Elba, (Entrance)	Germany	12	0	11
Elena, (Sta.) Port	Patog., E. Co.	4	0	17
Emden	Germany	12	0	
Endeavour, Riv.	Austral.,N.C.	8	0	5-10
English, Riv., Delagoa Bay	Africa, S. Co.	7	30	5
Essington, Port	Austral.,N.C.	3	24	13
Evangelist	Patag., W. C.	1	0	5
Exmouth	England	6	21	12¼
Exuma	Bahamas	7	20	2½
Eyemouth	Scotland	2	15	15
F.				
Fair Isle	Shetland	11	0	5
Falmouth	England	4	57	16
Famine, Port	Magellan Str.	12	0	6
Fayal	Azores	11	45	4
Fear, Cape	United States	7	0	7
Fécamp	France	10	44	23½
Fernando Noronha	Sth. Atlantic	4	0	6
Ferrol	Spain	3	0	15
Filey Bay	England	4	20	16
Finisterre, Cape	Spain	3	0	
Fishguard	Wales	6	56	11½
Flamboro' Head	England	4	30	16
Flamenco, Port	Chile	9	10	5
Flatholm Island	Bristol Chan.	6	54	37
Fleetwood, Port	England	11	12	26¼
Florida, Cape	United States	8	36	1¾
Flushing	Belgium	1	20	15
Folkestone	England	11	7	20
Formby, Point	England	10	35	28
Foulness, Crouch R.	England	12	5	14½
Fowey	England	5	14	15
Foynes Island	Ireland	5	35	15½
Francisco, San	California	10	34	8
Funchal Bay	Madeira	12	48	7

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise
		h.	m.	Feet.
G.				
Gaboon River	Africa	5	30	3
Gallaut (Port)... ..	Magellan Str.	9	0	5½
Gallegos (Port) ...	Patagonia EC	8	50	46
Galloway (Mull of)	Scotland ...	11	15	15
Galway	Ireland	4	35	14¾
Galveston	Gulf Mexico			4
Gambia River	Africa, W.Co.	8	10	6-9
Gambier Island ...	Austral S Co.	1	50	3
Gaspé Basin	Gulf St. Law.	1	50	5
Gay Head	United States	7	37	7
Geby, Fohou Isld.	Moluccas ...			5
George Shoals......	United States	10	30	7
Georgetown (Entr.)	United States	7	50	4¾
Geriah Harbour ...	Hindstn. WC.	2	40	9
Gibraltar	Spain	2	20	3½
Glasgow	Scotland ...	1	25	9
Glenan Isles	France	3	12	13
Gloucester (Cape).	Trr. delFuego	1	30	5
Goa	Hindstn. WC.	11	30	6
Goeree (West Gat)	Holland	1	45	7
Good Success Bay.	Trr. delFuego	4	3	6-8
Goree Road	Trr. delFuego	4	0	8
Gracias Cape, Harb.	Bay of Hond.	10	30	2
Grand (Port)	Mauritius ...	1	0	1½
Granville	France	6	13	37
Gravelines	France	12	0	19
Gravesend	England......	1	10	17½
Green Island	Riv. St. Law	2	45	16
Greenock	Scotland ...	12	8	9¾
Greenwich	England......	1	43	19
Grisnez (Cape) ...	France	11	27	21½
Guatulco	Mexico W Co.	1	30	5
Guayaquil	Ecuador......	7	0	11
Guaymas	Mexico W Co.	8	0	4
Guernsey Pier ...	Eng. Channel	6	48	26½
Gun Cay	Bahamas ...	8	30	3
Gundavee River (Entrance)	Hindostan W. Coast..	2	0	19
H.				
Haarlem	Netherlands.	9	0	
Hakluyt Head ...	Nova Zembla	1	30	4
Halifax	Nova Scotia.	7	49	6
Hamburg	Germany ...	5	29	6½
Hammerfest	Norway	1	10	9
Hammond Knoll...	England ECo.	7	40	
Handy (Port)	New Zealand	9	55	8
Hartlepool	England......	3	28	15
Harwich	England......	12	6	11½
Hastings	England......	10	53	24
Hastings Harbour..	Bay of Bengal	10	40	13½
Hatteras (Cape) ...	United States	9	0	5
Havana	Cuba			3
Havre	France	9	51	22
Haytien (Cape) ...	San Domingo	6	0	3
Helena, (St.) Bay..	Africa, W.Co.	2	30	
Helena, (St.) Isld..	Sou. Atlantic	3	11	3
Helgoland	Grmn. Ocean	11	33	9¼
Hellevoetsluys......	Netherlands.	2	30	8
Henlopen (Cape)..	United States	8	0	3-4
Henry (Cape)	United States	7	40	4
Herradura Point...	Chile	9	8	5
Hillsborough Bay..	Pr. Edw. Isld.	10	45	9½
Hobarton	Tasmania ...	8	0	4
Hokiango Riv.(ent.)	New Zealand	9	45	10
Hollesley	England......	11	30	8?
Holmes Hole	United States	11	43	1¾
Holy Island.........	England......	2	30	15
Holy Head	Wales	10	11	16
Honfleur	France	9	29	23½
Honoruru	Sandwich Ils.	4	0	2
Horn (Cape)	Trr. delFuego	4	40	9
Horn (or Blaavan Point)	Jutland	1	44	5
Houtman Rocks ...	Austra. N W C	11	30	2½
Howe, (West Cape)	Austral. S. Co.	9	0	6
Howth Harbour ...	Ireland	11	9	13
Huacho Bay	Peru	4	45	3
Hull	England......	6	29	20¾
Hunter (Port)......	Austral. E.Co	9	45	6-7
I.				
Ilfracombe	England......	5	42	27¼
Indus (Gizree Bunder)	Hindostan, W. Coast..	9	50	7
Inhambane River. .	Africa, E. Co.	4	15	10
Inverness	Scotland ...	12	18	12
Ipswich	England......	12	35	13½
Iquiqui Road	Peru	8	45	5
Islay	Peru	8	53	7
Ives (St.)	England......	4	44	21
J.				
Jacinto, San (Port)	Ticao Island, Filipines. .	6	30	6
Jackson (Port) ...	Australia ...	8	15	
Jask (Cape).........	Persian Gulf.	6	0	6
Jedore	Nova Scotia.	7	45	6½
Jericoacoara	Brazil	11	30	12
Jersey (St. Helier)	Eng. Channel	6	25	30¼
Jervis Bay	Austral. ECo.	6	20	6-9
Jiddah	Red Sea......			2
Johanna Island ...	Mozambique.	3	30	8½
John (St.)	New Brunsk.	11	23	23
John (St.)	Newfoundlnd	7	30	7
John, (St.) River. ,	Africa, S. Coa.	4	0	5
Joombas River ...	Africa, W.Co.	8	10	6
Juan de Nova	Madagascar..			5
Juan, San	Porto Rico...	8	2	1½
Juan, San (Port)...	Peru	5	10	3
Julian, San (Port).	Patagon. ECo	10	45	30
Junkseylon Island, East Side.........	Malacca Stra.	10	0	11½
K.				
Karakoa Bay	Owhyhee ...	3	49	
Katwyk	Netherlands	2	30	5
Kedgeree	Bay of Bengal	11	30	
Keeling Islands, Port Refuge......	Indian Ocean	5	30	5
Kelung Hr. Formoza	China Sea ...	10	30	3

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times.		Rise.
		h.	m.	Feet.
Kenmare River, West Cove	Ireland	3	52	10
Kentish Knock ...	England......	11	47	
Keppel Bay	Austral E. Co	9	30	9-14
Kildin Island	Lapland......	6	45	12
Killibegs	Ireland	5	16	11¼
Kilrush	Ireland	4	42	14
King Island.........	Bass' Strait. .	1	0	
Kingstown	Ireland	11	10	11
Kinsale	Ireland	4	43	11½
Kirkcudbright......	Scotland ...	11	10	23
Kishm, Kishm Isld.	Persian Gulf	11	0	12
Kooria Mooria......	ArabiaSECo.	8	20	6½
Krakatoa	Str. of Sunda	7	0	4
L.				
Lagos	Portugal ...	2	7	13
Lagos River.........	BightofBenin	6	0	2
Lambayeque Road	Peru	4	0	3
Lamo Harbour ...	Africa, E. Co.	4	6	11
Lancaster	England......	11	16	8½
Latham Island ...	Africa, E. Co.	4	0	10
Leith	Scotland ...	2	17	16½
Leman Shoal	England ECo.	6	0	
Lerwick	Shetland ...	10	30	6
Leubu River	Chile	10	30	5
Leven Port	Madagascar..	3	30	7½
Limerick	Ireland	6	16	18¾
Lindy River Entr..	Africa, E. Co	4	15	12
Lintin Island	China	12	0	7½
Lisbon Bar	Portugal......	2	30	16
Liscomb Harbour .	Nova Scotia..	8	0	6⅓
Littlehampton......	England......	11	36	16
Liverpool	England	11	23	26
Lizard Point	England	5	0	14¼
Loanda, San Paul..	Africa, W.Co.	4	30	5
Lobito Bay	AfricaSWCo.	2	20	5
Loheia................	Red Sea......	1	30	3
Loire River, Entr.	France	3	40	15¼
Lomas Point	Peru	8	19	5
Lombock, Ampanam Bay	Java Sea ...	8	0	6
London Bridge ...	England......	2	7	19¼
Londonderry	Ireland	8	1	7¾
Lookout Point ...	United States	12	32	2
Lopez (Cape)	Africa	4	30	5
L'Orient, (Port) ...	France	3	11	13
Louis (Port)	Mauritius ...	12	30	3
Louisburg Harbour	CapeBretonI.	8	0	5
Low (Port)	Patago. WCo.	0	40	7
Lowestoft	England......	9	57	6½
Lucas, San, Bay...	California ...	9	20	9½
Lundy Island	England......	5	15	27
Lyme Regis.........	England......	6	21	11½
Lynn Deeps	England......	6	0	23
M.				
Macao	China, E. Coa.	10	0	6½
Machias, Seal Isld.	Bay of Fundy	10	58	18
Macowa	Red Sea......	0	30	2
Macquarie Harb...	Tasmania ...	7	30	3

Places.	Situation.	Times		Rise.
		h.	m.	Feet.
Madame Island ...	Madagascar..	4	0	5
Madras Road	Coromandel Coast	7	34	3½
Magadoxa	Africa, E. Co.	4	30	8
Magdalen Island...	Gulf St. Law.	8	20	3
Magdalena, Santa, Island	Magellan Str.	12	0	10
Magdalene Bay ...	California ...	7	35	6¼
Mahons River	United States	9	52	7
Majambo Bay	Madagascar, W. Coast. .	4	30	16
Makumba River ...	Madagascar, W Coast..	4	45	17
Malacca Strait ...	Off Mount Formosa...	8	0	11
Malacca Road......	Malacca Str.	7	30	11
Malaga	Spain	12	0	3
Malè..	Maldives ...	12	30	3
Malo (St.)	France	6	5	35
Malpelo Point......	Peru	4	0	10
Man of War Cay..	Bay of Hond.	8	10	4
Manicouagan River	Riv. St. Law.	2	15	12
Manila, Luzon Ild.	China Sea ...	10	40	2½
ManukauHar. Entr.	New Zealand	9	30	13
Maranham	Brazil.........	7	0	17½
Marblehead	United States	11	30	12
Marcouf Strait......	France	9	55	20
Margate	England......	11	40	15½
Martaban......	Bay of Bengal	2	20	21
Martin, (St.) Cove.	Trr. delFuego	3	30	
Martin Vas Rocks	Sou. Atlantic	3	45	
Mary, (Cape St.). .	Bay of Fundy	10	30	19
Mary (St.)	Scilly Islands	4	27	16
Massowah	Red Sea......	1	0	3
Matan River	Gulf St. Law.	2	15	11
May (Cape).........	United States	8	19	6
Mayhé Island	Indian Ocean	4	0	6½
Mayotta Island ...	Mozambique	4	10	11¾
Mazatlan	Mexico, WCo	9	40	7
Mazeira Island ...	ArabiaSECo.	10	48	5
Meichen Sound ...	China, E. Co.	12	30	17
Melinda Point......	Africa, E. Co.	4	15	11
Mellacoree River...	Africa, W. Co.	7	40	11
Melo (Port).........	Patago. E.Co.	3	40	15
Mergui	Bay of Bengal	10	30	18
Merjee River	Hindos. WCo.	11	0	7
Mia-tao Straits ...	Yellow Sea. .	8	0	7?
Michael (St.)	Azores	12	30	6
Milford Haven......	Wales	5	56	24
Min Riv., Temple Pt.	China, E. Coa.	10	45	19
Mindanao	Filipines ...	7	0	6
Minehead............	England......	6	30	35
Mingan Harbour...	Gulf St. Law	1	16	7
Minow Island	Madagascar, W. Coast..	5	0	15
Mira-por-vos	Bahamas ...	9	30	3
Missisippi, S. W. Passage	Gulf Mexico			1½
Mocha Road, E.Co.	Red Sea......	12	0	4½
Mogador	Africa, W.Co.	1	8	11
Mombaza (Port) ...	Africa, E. Co.	4	0	11
Mongamie Harbour	New Zealand	8	15	9

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times. h.	Times. m.	Rise. Feet.
Monomoy	United States	11	30	5¼
Monterey	California	10	22	4¼
Montrose	Scotland	1	25	13
Monts, Port de	Gulf St. Law.	12	0	12
Morebat (Cape)	Arabia SE Co.	9	0	6
Moreno, Constitucion Road	Peru	10	0	4
Moreton Bay	Austral. E Co.	9	30	3–7
Morlaix Road	France	4	53	24
Mossel Bay	Africa, S. Coa.	3	15	6
Mount Dessert Ild.	United States	11	10	13
Mourondava	Madagascar, W. Coast	4	45	12
Mozambique Harb.	Africa, E. Co.	4	15	12
Mugeres Harbour	Bay of Hond.	9	30	1½
Mull of Cantyre	Scotland	10	35	4
Musa (Port)	Babuyan Ild.			5
N.				
Nagasaki Bay	Japan Sea	6	28	6¼
Nagore	Bay of Bengal, W. Coa.	8	15	
Nancowry Harbour	Nicobar Ilds.	9	15	8½
Nangka Island	Banca Stait			12
Nantucket	United States	12	24	3½
Narrinda Bay	Madagascar, W Coast	4	30	15
Nassau	Bahamas	7	30	3–4
Natal (Port)	Africa, S. Co.	4	30	6
Needles Point	England	9	46	7½
Negapatam	Bay of Bengal	5	0	3
Negro River	Patagonia	11	0	14
Nelson	New Zealand	9	50	14
New Bedford, Ent.	United States	7	57	4½
New Castle	United States	11	53	7
New Haven	United States	11	16	6¼
New London	United States	9	28	3
New Providence	Bahamas	7	30	4
New York	United State	8	13	5½
Newburyport	United States	11	22	9
Newcastle	England	4	23	10¼
Newhaven	England	11	51	20
Newport	United States	7	45	4½
Newport	Wales, S. Co.	7	10	24
Nicholas, (St.) Har.	Gulf St. Law.	1	55	12
Nicholson (Port)	New Zealand	4	30	5
Nicoya, Gulf	Cntrl. Amer.	3	9	10
Nieuport	Belgium	12	18	16
Ninepin Group	China, E. Co.	10	0	5
Noirmoutier	France	3	2	16
Nore	England	12	30	15½
Norfolk Island	South Pacific	7	45	7
Noss Island	Madagascar	5	0	15
Nuevo Gulf	Patago E. Co.	7	0	10
O.				
Ocracocke	United States	9	0	
Old Pt. Comfort	United States	8	17	3
Old Providence	Bay of Hond.	Irreg.		1
Oleron, Ile de	France	3	50	19
Onega River	White Sea	9	17	6–7
Oporto	Portugal	2	30	10
Orange Bay	Trr. del Fuego	3	0	
Orfordness	England	11	15	8
Ostend	Belgium	12	25	9
Otago Harbour	New Zealand	2	50	7
Otaheite	South Pacific	Noon.		1
Otway (Port)	Patago. W Co.	11	37	6
Ouro River	Africa, W. Co.	12	0	8–9
Ower Shoal	England E Co.	6	30	
P.				
Padstow	England	5	13	20½
Palmas (Cape)	Africa, W. Co.	4	30	4
Palmeira Point	Ceylon	9	30	7–11
Panama Road	Cen. America	3	23	15-22
Paposo	Chile	9	40	5
Para	Brazil, N. Co.	12	0	11
Passamaquoddy	Bay of Fundy	11	30	25
Passandava Bay	Madagascar, W Coast	5	0	15
Patta Bay	Africa, E. Co.	4	30	10
Paul de Loanda, San	Africa, S W Co	4	30	5
Paul, (St.) Island	Indian Ocean	11	0	3
Pei-ho River	China, Yellow Sea	4 10	0 PM* 45 AM‡	9–10 7
Pelew Islands	North Pacific			6
Pemba Channel	Mozambique	4	0	11
Pembroke Dk Yd.	Wales	6	12	21
Penang	Malacca Strt.	12	0	9
Penâs Cape	Trr. del Fuego	6	2	12
Peniche	Portugal	1	54	
Penmark Rocks	France	3	16	
Pensacola	Gulf Mexico			2
Pentland Firth, W. Side	Scotland	9	35	
Penzance	England	4	30	16
Pernambuco	Brazil	4	23	6
Peros Banhos	Indian Ocean	1	30	5
Pescadore Islands	China Sea	10	30	9½
Peterhead	Scotland	0	34	10¾
Philadelphia	United States	1	18	6¾
Philip, (Port) Capel Bay	Austral. S. Co.	2	30	3–4
Pichidanque Bay	Chile	9	20	5
Picton Harbour	Nova Scotia.	10	0	6
Pillar (Cape)	Tasmania	1	0	6
Pisco Bay	Peru	4	50	4
Placentia	Newfoundld.	9	15	8
Plettenberg Bay	Africa, S. Co.	3	10	6
Plymouth Breakw.	England	5	37	15½
Plymouth	United States	11	19	11½
Pomba Bay	Africa, E. Co.	4	0	15
Poole	England	9 12	10 45	6½
Portendik	Africa, W. Co.	10	0	6
Portland	United States	11	25	10
Portland Breakwr.	England	7	1	6¾
Port Madoc	Wales	7	30	17
Porto Prayo	C. Verde Ils.	6	0?	5
Portsmouth D. Yd	England	11	41	12½

* April to July
‡ August

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times. h.	m.	Rise. Feet.
Portsmouth	United States	11	23	10
Post Office Island	Galapagos ...	2	10	6
Pouinipet Island...	Caroline Isld.	6	0	4½
Princes Island ...	Bight of Biafra	3	45	4½
Puget Sound	Amer. N W Co	6	0	18
Pulicat Shoals	Coromandel Coast	9	25	2¾
Pulo Condore	China Sea ...	3	0	4
Q				
Quebec...............	Canada	6	38	18
Queda	Malacca Strt.	12	0	5½
Queen Charlotte Sound	New Zealand	8	50	8
Quentin, Port San	California ...	9	5	9
Queenstown.........	Ireland	5	1	11¾
Quilca River	Peru	8	0	6
Quilimane Riv. Ent	Africa, E. Co.	4	15	16
Quiloa Harb.	Africa, E. Co.	4	45	12
R.				
Rachada (Cape) ...	Malacca Strt.	5	30	13
Radama (Port) ...	Madagascar, W. Coast..	4	40	13
Ragged Island......	Java Sea ...	8	10	3
Ragged Point	Borneo, E Co.			7
Raine Island	Torres Strait	8	10	10
Rajahpoor Harbour	Hindos. W Co.	11	0	12
Ramsey	Isle of Man..	11	12	19¼
Ramsgate............	England......	11	44	15
Rangoon	Bay of Bengal	5	30	21
Ras-el-Khyma	Persian Gulf.	11	0	7
Realejo...............	Cen. America	3	6	11
Rendesvous Island.	Borneo, S.W. Coast			8
Resolution Bay ...	Marquesas...	2	30	4
Rio Janeiro	Brazil.........	3	0	4
Rocas	Sou. Atlantic	5	15	10
Rochefort	France	4	6	17
Rochelle	France	3	31	17
Rodrigue Island ...	Indian Ocean	1	45	6
Roque, (Cape S.)..	Brazils			10
Rotterdam	Netherlands.	3	45	7
Rouen	France	2	28	
Royal Har., Rustan	Bay of Hond.	7	45	3½
Rush (Port).........	Ireland	6	8	5¼
Rye Bay	England......	11	20	22
S.				
Sable (Cape)	Bay of Fundy	8	30	9
Sable Isld., N. Side	Nova Scotia.	7	30	4
Sable Isld., S. Side	Nova Scotia.	6	30	4
Saintes	Caribbn Sea	6	45	
Salcombe	England......	5	41	15
Saldanha Bay	Africa, W.Co.	2	0	6
Salem	United States	11	13	0½
Saltees	St. George's Channel...	5	40	
Salvador, San (Port)	Falkland Ids.	8	10	8
San Blas	Mexico W Co.	9	41	6½
San Lucar	Spain	1	53	12½
Sandalwood Bay...	Fijii Islands	6	0	6?
Sandy Hook	United States	7	29	5½
Sandy Island	Madagascar, W. Coast	5	0	15
Sanguir Island......	Moluccas ..			6
Santa Cruz River..	Patago. E.Co.	9	30	40
Santa Maria Island	Chile	10	20	6
Santandar	Spain	3	30	15
Saparooa Island ...	Moluccas ...			6
Saugor Island	Bay of Bengal			12
Savannah, Entr. ...	United States	7	20	8
Scalloway	Shetland ...	9	30	5¾
Scarborough	England......	4	11	15¾
Scarcies Rivers ...	Africa, W.Co.	7	10	10
Scilly (St. Agnes)	England......	4	30	16
Sea Bear Bay	Patago. E.Co.	12	45	20
Seal Isld., C. Sable	Bay of Fundy	9	0	12
Sebastian, San......	Brazil	2	0	4
Seìn, Ile de	France	3	21	17¼
Selsea Bill	England......	11	45	16½
Senegal	Africa, W.Co.	10	30	
Serrana Bank	Mosquito Co			2
Setubal	Portugal......	2	30	8
Seven Islands	Lapland......	8	20	12
Seven Islands Bay	Gulf St. Law.	1	40	9
Sheerness............	England......	0	37	16
Sheet Harbour ...	Nova Scotia.	8	6	6½
Shelburne	Nova Scotia.	8	30	8
Sherbro River	Africa, W.Co.	6	0	11
Shields, North......	England......	3	23	13¼
Ship Harbour	Nova Scotia..	7	54	6½
Shoal Water Bay..	Austral. ECo	10	30	12-18
Shoreham	England......	11	34	18
Sierra Leone	Africa, W.Co.	7	55	8
Simon's Bay	Africa	2	44	5¼
Simon's, St., Isld..	United States	7	43	8¼
Singapore............	Malacca St...	9	45	10
Sisal..................	Gulf Mexico			2
Sitka	Amer. N W Co	0	34	
Skerries	Ireland, N Co.	6	15	5
Sligo Bay............	Ireland	5	18	11¼
Slyne Head	Ireland W Co.	4	30	13¼
Smerwick	Ireland	3	50	11½
Sofala River.........	Africa, E. Co	4	0	19
Southampton	England...	10 12	30 45	13
Southwold	England......	10	20	6½
Spain, (Port)	Trinadad ...	4	30	4
Spurn, Point	England......	5	26	18¾
Staten Island	Trr. del Fuego	4	30	8
Stephen (Port) ..	Austral. ECo.	9	0	6
Stephen (Port) ...	Falkland Ils.	7	45	7½
Stirrup Cay	Bahamas ...	7	0	4
Stockton (Tees) ...	England......	4	40	11
Stonehaven	Scotland ..	1	10	14
Stornoway	Scotland ...	6	46	13
Strangford Bar ...	Ireland	10	53	14
Strangford Quay ...	Ireland	12	31	10½
Stromness	Orkneys ...	9	0	10
Suez Bay	Red Sea......	2	0	6
Sunderland	England......	3	22	14½

TABLE LVII.

TIMES OF HIGH WATER.

Places.	Situation.	Times. h.	Times. m.	Rise. Feet.
Supé Bay............	Peru	4	50	3
Surat	Hindos. WCo	4	0	19
Surinam	Guayana ...	6	0	9
Swan River	Austra. WCo.	9	0	14
Swansea	Wales	6	1	$27\frac{1}{4}$
Sydney...	Austral. ECo.	8	38	$4\frac{3}{4}$
Sydney Harbour ...	Cape Breton.	9	0	5
T.				
Table Bay	Africa, W.Co.	2	40	5
Taichow Island ...	China, E.Co.	9	0	14
Talcahuano	Chile	10	14	5
Tamar Port	Magellan Str.	3	5	5
Tamareed	Indian Ocean	7	20	8
Tamatave	Madagascar..	4	18	8
Tangtang Harbour	Madagascar..	4	30	6
Tanna	New Hebrds.	5	35	3
Tappanooly Harb..	Sumatra......	6	10	6
Tarbert	Ireland	4	57	$14\frac{1}{2}$
Tarifa	Spain	1	46	6
Tarpaulin Cove ...	United States	8	4	$2\frac{3}{4}$
Tavoy River	Bay of Bengal	10	30	20
Tay River (Bar) ...	Scotland ...	2	6	16
Tees River (Bar)...	England......	3	45	15
Teignmouth.........	England......	6	0	13
Teneriffe	C. Verde Ils.			$8\frac{1}{2}$
Terceira	Azores	12	32	$4\frac{1}{2}$
Terschelling, West.	Netherlands.	8	40	6
Texel	Netherlands.	6	30	4
Thirsty Sound......	Austral. ECo.	10	45	12-18
Thomas, (St.) Isld.	Africa	3	25	$4\frac{1}{2}$
Three Points (Cape)	Africa, W. Co	4	0	4
Tien-pak Harbour.	China, E. Co.	12	0	$8\frac{1}{2}$
Tinghae, Chusan...	China, E. Co.	11	0	12
Tobago	Caribbn. Sea	Irreg.		$3\frac{1}{2}$
Tongatabu	South Pacific	6	50	4
Torbay...............	England......	6	0	$13\frac{1}{2}$
Townshend Harb..	Trr. del Fuego	2	30	5
Townshend Port...	Oregon	3	49	$5\frac{1}{2}$
Treguier	France	5	32	25
Triangles	Gulf Mexico			$1\frac{1}{2}$
Trincomalee	Ceylon, S. Co.	8	18	2
Tristan d'Acunha..	Sou. Atlantic			8
Tynemouth (Bar)..	England......	3	20	$14\frac{3}{4}$
Typa Anchorage ...	China, E. Co.	10	0	7
U.				
Union Bay	La Plata ...	3	10	12
Upstart (Cape) ...	Austral. ECo.	11	0	6–8
Ushant...............	France	3	32	$19\frac{1}{4}$
V.				
Valdivia, (Port) ...	Chile	10	35	5
Valentia Harbour..	Ireland	3	42	11
Valery, St. en Caux	France	10	46	27
Valery, (St.) sur Somme.......	France	11	46	27

Places.	Situation.	Times. h.	Times. m.	Rise Feet.
Valparaiso	Chile	9	32	5
Vera Cruz	Gulf Mexico			2
Verde (Cape)	Africa, W. Co.	7	45	5
Versavah	Hindos. WCo	12	15	16
Vincent, (Port St.)	N. Caledonia	5	50	$4\frac{1}{2}$
Virgin (Cape)	Magellan Str.	8	30	36-42
Volcano Islands ...	China, E. Co.	11	30	15
W.				
Wahaay Harbour..	Moluccas, N. Coast	6	0	3
Walvisch Bay	Africa, W. Co.	1	54	6
Wangarva Harbour	New Zealand	8	15	7
Warren Point, Carlingford	Ireland	11	10	$14\frac{1}{2}$
Waterford Bridge..	Ireland	6	6	$13\frac{1}{2}$
Wellesley Island...	Austral, NCo.	7	30	8–12
Weser (outer Light Vessel)	Germany ...	11	30	
Western (Port) ...	Austral. S. Co.	1	10	8
Westness	Orkneys ...	9	11	10
Westport	Ireland	4	57	$12\frac{3}{4}$
Wexford	Ireland	7	21	5
Whampoa Docks..	China In March	1	40	7–8
	In April..	1	15	
	In May. & June.	0	30	
Whitby	England......	3	45	15
Whitehaven.........	England.. ...	11	14	$23\frac{1}{4}$
Wick	Scotland......	11	22	10
Wicklow	Ireland	10	29	9
Wilmington..... ...	United States	9	6	3
Wilson Promontory	Austral. S. Co.	2	0	10
Winterton Ridge...	England......	7	50	
Wisbeach............	England......	7	30	15
Woodbridge Haven, (Bar)	England......	11	45	12
Woolwich	England......	1	37	$18\frac{1}{2}$
Wranger Oog	Germany ...	12	0	9?
Wrath, (Cape)......	Scotland ...	7	30	$15\frac{1}{2}$
Wusung Riv. Entr.	China, E. Co.	1	30	12
Y.				
Yang-tse-Kiang Ent	China, E. Co.	12	0	15
Yarmouth Road ...	England......	9	15	6
Yarmouth	Isle of Wight	10 12	0 AM 0 PM	7
Yellaboi	Africa, W. Co.	7	10	10
Ylo Road............	Peru	8	15	6
York Factory	Hudson Bay.	11	15	10-14
Youghal	Ireland	5	14	$12\frac{3}{4}$
Z.				
Zanzibar	Africa, E. Co.	4	20	10

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